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The Estrellas Observatory
Fort Worth, Texas

By OSCAR E. MONNIG

An observatory without a dome is greatly to be desired, but when it is situated some 15 miles from the residences of its users, the wish to leave apparatus stored at the site instead of constantly hauling it on long rides makes a protecting building of some kind a necessity. And that situation accounts for the further project of the Texas Observers herein related.*

It was natural to construct our observatory around the pier of our already erected photographic mounting, which was situated on the southern portion of a moderately elevated ridge. Outcropping rocks on the ledges of the surrounding hills, within half a mile of our site, furnished all the material needed for walls that would make our observatory fort-like in strength. Three loads of rock were hauled as a beginning, with mules and wagon, and starting in April, 1930, week-ends were dedicated to the work.

The foundation was laid off with an engineer's transit to insure walls running in the cardinal directions—one of those scientific touches not at all necessary, but in which the amateur can afford to indulge, since he is not getting paid for his efforts. Outside dimensions of 12 by 14 feet were adopted, and trenches about a foot deep and 8 inches wide were dug for the foundation. With cement, sand, and gravel delivered on the spot, the expense and hard work of the venture began. The foundation was poured, but not so quickly as the clause is written, for the mixing was all by hand.

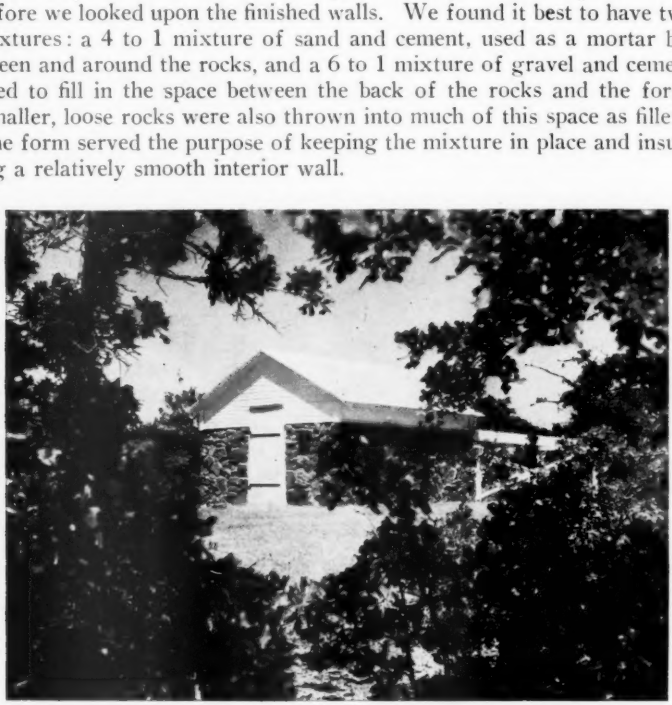
The rock used for the walls is mostly of a reddish brown color, certainly due to prevailing iron compounds. Much of it is cut through with numerous drip holes, but the rock is not so soft as this action of water might imply. Many of the pieces are covered with variegated types of lichen, which add greatly to the beauty of the finished structure, especially just after rain. Even the terrific Texas summer sun has so far failed to injure the decorative moss.

Two forms were made of shiplap, held together by vertical 2x4's, and set up on one corner of the selected site. They were slightly shorter

*A former account of the activities of this group and details relating to their photographic mounting appeared in POPULAR ASTRONOMY, **38**, 317, 1930.

than the dimensions decided on for the sides, and a little higher than the proposed height of the wall. These forms were set up exactly vertical, and held firmly in place by braces. The reader has probably already guessed that the walls were built as far as the forms extended, and the forms then shifted to another corner, where work was resumed.

Masonry was carried on for many a Saturday and Sunday afternoon before we looked upon the finished walls. We found it best to have two mixtures: a 4 to 1 mixture of sand and cement, used as a mortar between and around the rocks, and a 6 to 1 mixture of gravel and cement used to fill in the space between the back of the rocks and the form. Smaller, loose rocks were also thrown into much of this space as fillers. The form served the purpose of keeping the mixture in place and insuring a relatively smooth interior wall.



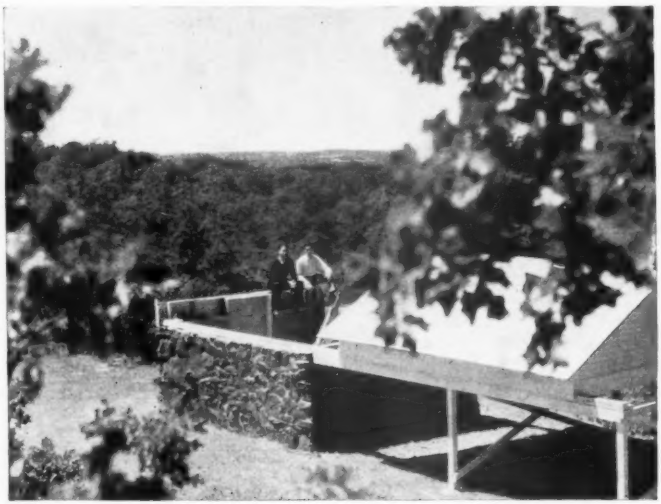
A View of the Estrellas Observatory from the Southeast.

No attempt at all was made to keep the exterior faces of the wall even; on the contrary, they were made as rugged as possible in order to give a rustic touch. It will be seen from the illustrations that "face rocks"—those set on edge so as to expose most of their surface for the sake of its beauty—had to be interspersed frequently with rocks laid flat, and showing only the edges. The latter are not pretty, but add materially to the strength of the structure. It is of particular importance to work them in at the corners, sometimes running along one wall, sometimes along the other. Such criss-crossed tie rocks assure a stability not otherwise to be achieved.

The building has no windows, but a three foot space was left in the

south wall for a door. Upright 2x8's, held in place by bolts which had been previously set into the cement, made the sides of the door frame, the necessary parts for two strap gate hinges having also been inserted into the concrete at one side of the doorway. Long bolts inserted into the cement mixture at regular intervals all the way around the tops of the walls provided a means of subsequently bolting on 2x8's.

The framework which forms the base of the roll-off roof is essentially a rectangular arrangement of 2x6's, with braces in the corners to insure a permanent squareness, and with four iron rollers bolted on at the sides. The rollers run on shafts which are solid except for a small hole drilled thru them and fitted with Alemite (Zirk) tips for greasing. Rollers equipped with ball or roller bearings would be preferable, but we could not readily find the desired type or size at the time.



LOOKING DOWN ON THE OBSERVATORY FROM A TREE JUST NORTHEAST OF IT. THE ROOF IS NOT QUITE ALL THE WAY OFF.

The roof is built up from its base with 2x4's for joists and rafters; the covering is of shiplap, topped with white asphalt roofing. This construction made a really waterproof roof, as well as a practically fireproof one; the latter feature was deemed desirable because local fires in the surrounding trees and brush might become quite destructive in dry seasons. An unexpected result of the white roofing and the white paint with which the few exposed wood portions were finished off was to make the building harder than ever to photograph; we had already found that with ordinary film the brown rock walls showed a strong tendency to merge into the background of green scrub oaks, and now

the white roof and blue sky provided another matching of similar actinic values! The only method by which proper contrast could be secured was the use of panchromatic films and a K3 filter, and the illustrations here reproduced were so made.

The door is made of two thicknesses of shiplap; the gables are covered with ordinary pine siding; and the open portions under the eaves are closed in with long boards notched to fit the rafters. These pieces are set out just far enough so that they do not rub when the roof rolls off, but the clearance is slight—only about a quarter of an inch.

Four 4x4 posts, set in concrete, hold the runway for the roof, and the two sets of X-braces add greatly to its stability. It would have been better to have another pair of posts next to the main structure. On top of the runways are 2x4's, on the inner edges of which ⅛-inch strap-iron tracks, 2 inches wide, are screwed in place. A similar construction is continued along the tops of the side walls of the building; there are two joints of this track on each side, and great care was taken to lay them parallel and level.

The entire roof can be rolled off or on by two persons pushing on it, but the job requires moderate exertion. We plan to add a winch arrangement, which should lessen the amount of work here involved. The weight of the roof is quite sufficient to hold it on, even during very high winds, but for additional safety, and to prevent persons from pushing the roof off in order to gain access to the building, we fastened some angle irons on the inside of the north wall, with holes in them and in the joist directly over them, through which large pins can be dropped when the roof is in place.

The height of the walls (five feet) and the length of the runways were determined by strictly astronomical considerations. The east and west sides are so low that we can photograph to the very horizon, which may at times be necessary, as in the case of comets near the sun. We have already found this feature of value, and were able to secure five sets of photographs of Nagata's Comet, 1931 *b*; one, with an exposure of only four minutes, very close to the horizon and with the moon three days past first quarter, shows a clearly recognizable though faint and small image of the comet.

To the south, the lower portion of the woodwork just above the stone remains in place when the roof is rolled off; while this cuts off some 15° in that direction, the loss is of no great importance because of the very short exposures that can be secured so close to the horizon, to say nothing of the troubles of absorption. If necessary, a short picture of an object near the meridian can be taken through the doorway—a method we used successfully in the case of Omega Centauri. To the north, the roof rolls off sufficiently far to allow the region around the pole to be seen from all positions of the guide instrument, which is a point of special importance for the work of setting the polar axis. The loss of the region beneath the pole is immaterial, as it is an area where photographs

would be desirable only in rare instances, as in the case of a circumpolar comet like the recent Comet Peltier-Whipple, 1932 *h*. Moreover, from our location the glow of the lights of Fort Worth affects the sky somewhat to an altitude of 10° or more in the north. Even the faint glow of Dallas, 30 miles just north of east from us, is sometimes mistaken by the uninitiated for the earliest sign of a rising moon.

The original sand floor had its advantages: it could be easily cleaned or renewed, was kind to objects accidentally dropped upon it, and comfortable to stand or walk on. Its use, however, resulted in the production of a finely ground dust that was very objectionable, especially when any wind was blowing, and we have accordingly just finished replacing it with a cement floor. This is three inches thick, and is separated from the pier to avoid vibrations; we hope to cover it with cork linoleum. The building is not tightly sealed, and no trouble has been experienced from condensing moisture. The interior is sufficiently dark, on moonless nights, to allow one to change or load the most sensitive plates without fear of fogging them.

Instead of a cornerstone, which would have been difficult to make and expensive to buy, we decided on a brass plate about 12 by 14 inches in size. Raised lettering was cut by hand, with a chisel and a pocket knife as tools, on a Plaster of Paris form of the size of the proposed plate; from this form a local brass foundry cast the plaque, to which bolts were brazed for fastening through the wall. The legend, "TEXAS OBSERVERS, 1930," followed by the names of the five original members of the group, is evidently at least somewhat ambiguous, for one old man in the neighborhood has been known to refer to the building as a "monument," presumably thinking that it housed the remains of those whose names are cut on the brass plate!

Surprisingly few animals have turned astronomer. One persistent field mouse had to be repeatedly discouraged before it gave up the idea of establishing a permanent nest in the boxed-in space near one of the rollers, and a certain type of moth has found the building much to its liking. The relatively elevated and dry location makes mosquitoes rare except in the dampest of weather; and the rocky, sandy soil, supporting a minimum of vegetation, assures the absence of weeds and accompanying chiggers—which would certainly be a drawback to astronomical pursuits!

The furniture consists of a short bench for general use and a very small table which holds a National Thrill Box radio and the necessary batteries; our isolated location leaves us without any regular power supply. This radio has a range of 18 to 526 meters; we are able to receive the Arlington time signals directly, and hope eventually to undertake a program of occultation observing. By using the higher wave coils and a loud speaker attached to the inside of the roof, one may have the rare experience of guiding for a photograph and listening to beautiful music at the same time—a combination which is at times truly in-

spiring, and which we dare say even professional astronomers have not often achieved. Some of the neighboring farmers have wondered at music coming from the woods at night, and the closed house without windows has aroused the proper amount of curiosity.

Some fifty feet away from the building is a little roughly circular open space, separated from the immediate surroundings by low trees; this spot we reserved as "Meteor Clearing," a space from which naked eye observations could be made at any time, and dim lights turned on for recording observations. Lights within the observatory or just outside it are strictly taboo during photographic work, as we take no chance of interfering with a picture that we drive thirty miles to get.

The approximate position of the observatory, as measured on a large scale reconnaisance map, is $\phi = 32^\circ\ 33'.6$ N; $\lambda = 97^\circ\ 16'.4$ W. The location is near the southern edge of the county that Fort Worth lies in, and is farther south than any of the observatories in the United States listed in the 1933 *American Ephemeris*, except that at Tucson. The altitude of the top of the pier was found to be 747.1 feet above mean sea level, the levelling having been done by Brown, assisted by Monnig, working from a U. S. Coast and Geodetic Survey benchmark in Burleson, three miles to the southwest.

It has been more difficult to decide upon a name than to erect the structure, but we have tentatively followed a suggestion made by Bunch, who went to Spanish for "Las Estrellas," "the stars." While the dropping of the article and the Anglicizing of the pronunciation make this origin somewhat obscure, they at least produce a name which is both distinctive and euphonious, and hardly capable of being mispronounced.

The cost of the materials for the entire building was slightly in excess of $100. The observatory is essentially a product of group work; no one of us alone would have possessed the many requisites necessary for its successful completion. Besides the original "Texas Observers," Brown, Bunch, Logan, Monnig, and Sanders, there are two of our newer members who aided mightily in the construction of this building: Messrs. Ambrose Burns and Milton Mehl. To Robert Brown must go the chief credit for the inspiration, the general plans, and the overcoming of the many unforeseen obstacles that arose in the course of the execution of our scheme. No formal set of plans or specifications was available or ever made; we planned as we built, and we built entirely without outside help, in order that we might say at last, "our observatory."

The Meteors of 1930 November 19

By WILLARD J. FISHER

On the evening of November 19, 1930, word came to Professor Caroline E. Furness, at the Vassar College Observatory, about the flight of a brilliant meteor across the Hudson Valley in the neighborhood of Poughkeepsie. Miss Furness immediately sought the assistance of the press, made investigations both by telephone and by personal visits, and telegraphed Director Harlow Shapley, at the Harvard Observatory. The Harvard Observatory immediately appealed to the Boston newspapers for assistance in collecting data. Also at Mount Holyoke College Observatory reports of meteors were received, and Professor Anne S. Young and Mrs. F. S. Hogg appealed to the press of the Connecticut Valley. Professor C. P. Olivier, Director of the Flower Observatory and President of the American Meteor Society, loaned seven reports collected by him. In consequence a total of about 126 written communications was received, with many telephone calls. At a conference of the different astronomers concerned, at New Haven, during the December meeting of the American Astronomical Society, it was decided to turn over the data to the writer, for reduction.

The places of observation being plotted on a map of the region concerned, scale 25 miles to 1 inch, they were found bunched near New York City, in the neighborhood of Poughkeepsie, in the Connecticut Valley in Massachusetts, and about Boston, with scattering points from Belmar, N. J., to Portland, Me. This distribution represents in part the areas of special newspaper appeals, in part the areas of denser population.

Reports of meteors passing nearly or exactly overhead were received from the neighborhood of Poughkeepsie, from Chester, Mass., from the neighborhood of Holyoke, Mass., and from Quincy, Mass., all as about 4:45 P.M., Eastern Standard Time. In most cases this means, properly, about a quarter to five. Reports of meteors definitely at other times within a half hour will be mentioned also in the following. It would seem that no person reported seeing more than one of the meteors to be treated here.

(1) Hurley, N. Y., H. F. Dunbar, Instructor in Science, Kingston High School; very nearly 4:40; passed over this village; disappeared before reaching the horizon; going due southeast by compass; sky clear except in NW; one could read fine print with ease.

New Paltz, N. Y., Miss M. O. Baker, student in New Paltz Normal School; 4:40 within one minute; as if directly over New Paltz; shot out of what appeared to be a clear non-star sky. [The flight was apparently toward the SE.]

Pleasant Valley, N. Y., O. C. Rossnay; about 4:45; directly over my

head . . . rapidly descending toward the SE . . . [vanished about halfway to horizon].

Stormville, N. Y., Mrs. H. L. Warwick; about 4:45; almost directly over where I was standing . . . and went toward the S or SE.

Poughkeepsie, N. Y., Miss D. Conklin; 4:45; path nearly straight down, in SE by compass; altitude when first seen, about 60°.

The meteor passed over the area indicated by these reports; as the first observation is probably the most skillful, the meteor will be called the Hurley meteor.

Other observations of the same meteor are:

Rockville, Ct., Mrs. A. R. Rough; about 4:45; the meteor passed as if from NW to directly S; horizontal path.

South Amherst, Mass., C. V. Thayer, Scout; 4:45; started about SSW and burned out a little to the E of S, about 25° to 30° above the horizon; "I think I saw its whole flight"; details of landmarks noted.

Massapequa, Long Island, Rev. P. B. Cobb; about 4:45; initial position a little W of due N, about 40° altitude; final position, after a path to E of about 70°, altitude about 35°.

Holyoke, Mass., Miss M. Gesner; no time stated; comparing her sketch map with a U. S. Geological Survey topographical map, from SWbW to SbE; estimated final altitude, 15°.

Great Neck, Long Island, N. Iedema, observer of the A.A.V.S.O.; a little after 4:45; initial position, about halfway from northern horizon to zenith; final position, to the right (=E), about 30° altitude; sky clear.

New York City, walking N on Park Avenue, J. Burke; about 4:50; initial, N, 55° to 60° altitude; final, E or perhaps a bit SE, altitude 55° to 60°.

Drawing a straight line on the map through Hurley with the given bearing, it passes between Southampton and Sag Harbor, at the east end of Long Island. Lines drawn from Rockville, etc., with the given bearings of final positions intersect the Hurley line and each other within about 11 miles of this point, which may then be taken as the sub-final point of the meteor's path. An observation by Rev. H. Hinrichs, Towaco, N. J., agrees well with the others, the line of final bearing passing nearly through Southampton, but the time given is about 4:30. Perhaps this time is wrong, and the observation belongs to this meteor.

The sub-initial point of the path is not well determined. It obviously lies to the NW of Hurley somewhere; according to Mr. Hinrichs' initial observation it is Phoenicia, in the Catskill Mountains.

All other reports seemingly dealing with this meteor are too vague for plotting azimuth rays, or else with regard to time.

Assuming that the line through Hurley toward magnetic SE defines the vertical plane of motion of this meteor, altitudes in miles are computed as follows, for the final point as observed at various stations:

Pleasant Valley-South Amherst, distance 93, altitude 45°, height 94.

South Amherst-Hurley, distance 94, altitude 25° to 30°, height 50. Massapequa-Hurley, distance 60, altitude 35°, height 42.5. Holyoke (Miss Gesner)-Hurley, distance 91, altitude 15°, height 25. Great Neck-Hurley, distance 88, altitude 30°±, height 52. Park Avenue-Hurley, distance 99, altitude 55° to 60°, height 156.

These show the disagreements usually found, consequent upon errors of estimating and remembering angular altitudes. The mean of the South Amherst, Massapequa, and Great Neck results is 48 mi = 77 km, final point over Southampton, Long Island, or within a few miles of that point.

No results can be deduced for the initial point, as only the Towaco initial bearing indicates an initial point near or to the west of Hurley or New Paltz; and the time at Towaco, 4:30, makes this use of the observation very doubtful. The true time of apparition is probably 4:40, as given both at Hurley and New Paltz. Not knowing the initial point with any certainty, the whole duration of flight cannot be found; but certain distances on the ground may be used with reported times of flight.

Southampton-New Paltz, 107 mi, perhaps 1½ seconds; projected speed about 71 mi/sec.

South Amherst, initial and final bearings, on Hurley line, distance 41 mi, not over 1 sec, projected speed not under 41 mi/sec.

Massapequa, initial and final bearings, on Hurley line, distance about 70 mi, about 2 sec, projected speed about 35 mi/sec.

As the conditions of observation, involving broadside view of the path, were better at South Amherst and at Massapequa than at New Paltz, the value 38 mi/sec = 61 km/sec is probably fair for the projected speed. The true speed would be greater than this, but cannot be computed without a better knowledge of the slope of the path. Both the South Amherst and Massapequa altitudes and the Rockville report indicate that the slope was small, and hence that the true speed through the air was not much greater than 38 mi/sec. This is well within the limits of probability, as very many of the geocentric velocities recorded in the von Niessl-Hoffmeister Catalogue of 611 Great Meteors run above 50 km/sec. As the slope is uncertain, no radiant, and hence no orbit, can be deduced.

The fireball is described as follows:

Hurley; markedly blue color, suggesting the flame of burning zinc.

New Paltz; a beautiful green.

Pleasant Valley; a very pale blue light . . . seemed to get smaller as it approached the horizon.

Stormville; looked like a sky rocket, had a silver ball, not awfully large, and left a short, light or gold line . . . just seemed to disappear in the clear sky.

Poughkeepsie (Miss D. C.); yellow white rather than blue white.

Rockville; . . . it burned out . . . travelled horizontal till it changed

color, then dropped to disappear in the air. As it dropped it changed to a golden colored bar . . . As the color changed from golden to red, it shortened till the last of it broke into tiny spots of red color and faded away.

South Amherst; distinct bluish color, trailing sparks like a fireworks sparkler . . .

Massapequa; so bright that it stood out against the light of the sky as if it were dusk instead of almost broad daylight; color white, with perhaps a yellowish tinge; train followed closely, had blue in it . . . resembled a large and bright rocket.

Holyoke (Miss G.); green, very bright, had tail; disappeared in air.

Great Neck; color bluish, much brighter than Venus at night . . . appeared disc-like, tapering off to a point behind and leaving a short streak. . . .

Park Avenue, New York; much greater than a shooting star, mixture of green, yellow, and white.

Many other reports no doubt refer to this same object. On account of the absence of detonations and the final height of about 48 mi there is no likelihood that meteorites fell from it.

(2) A meteor was observed at various points in the Connecticut Valley, passing overhead or at a high angular altitude, coming from a northerly point. This may be called the Holyoke meteor.

Wapping (Deerfield), Mass., P. Hawks; between sunset and the appearance of stars [sunset at Deerfield was at 4:25, E. Standard Time, by atlas maps and the American Nautical Almanac]; first caught near the high noon position of the sun in August; course "easterly by south" . . . exhausted when it had travelled the arc of a 45° angle from where I first saw it.

Northampton, Mass., in front of Draper Hotel, J. Morange; no time given; saw it "in the sky over the City Hall . . . shoot down toward Mt. Tom on an angle." Miss M. Williams, of the Smith College Observatory, estimates from these, initial azimuth S 25° W, altitude perhaps more than 20°. "If it was going toward Mt. Tom it was moving toward the meridian and slightly downward."

Holyoke, Mass.,—Mitchell; 4:45 nearly, by watch; over his head; going W to E.

Near Holyoke, Mass., on high bank, east side of the Connecticut River, (name of observer to be withheld); about 4:50; evidently moving almost N and S; . . . "am positive I saw it against the hills as a background, Mt. Nonotuck-Mt. Tom stretch, . . . passed just above Mt. Nonotuck . . . seemed to die out just over the Canoe Club."

Mt. Holyoke College Campus, in front of the Art Building, Miss B. Burt; 4:45; it came from the direction of the Mt. Tom range, disappeared in direction of Clapp Laboratory [=S 30° E±, map of Campus].

Mt. Holyoke College Campus, no name on report, (but received from

Prof. Anne S. Young) ; about 4:45 ; it came from the N—that is, from over Mary Lyon—and disappeared down over the Music Building [by Campus map, from N 25° W± to S 15° E±].

South Hadley Village Cemetery, no name on report, but from Miss Young ; 4:45 to 4:50 ; came from Mt. Holyoke [mountain], disappeared back of Pearson's (by Campus map, = S 10° E±).

Mt. Holyoke College Campus, Miss R. Allen ; 4:50± ; place, South Campus in front of Wilder ; it came from over Mead, and went toward the Tennis Courts [by Campus map, final position S 50° E±, altitude more than 35°].

Worcester, Mass., Shrewsbury St., Rev. W. A. Wood ; 4:47 by watch immediately ; was facing due W ; slope, "sharp declination," right to left = N to S.

Allerton, Mass., Mr. and Mrs. W. G. Christie ; hour not stated ; very low in western sky, "falling nearly due south."

South Weymouth, Mass., G. W. Ecker ; 4:48, exactly, watch ; "moving in a south-southwesterly direction" ; was looking towards the western horizon ; it appeared out of the NW.

Boston, Mass., Columbus Avenue, R. B. Hill ; 4:45± ; in the western sky, apparently about 45° up from the horizon . . . from N to S in almost a straight arc.

Amherst, Mass., Mrs. O. Reiman saw a meteor passing high over the ridge of a house which faces east, and which she was just entering ; it sank out of sight beyond fir trees toward SE ; time, perhaps 4:40 or shortly before 5:00.

Amherst, Mass., campus of Massachusetts Agricultural College, R. L. Snow ; about 4:45 ; meteor apparently travelling south,—toward the Holyoke range ; burned out before coming to earth.

The time of apparition of this meteor was probably 4:47, mean of three watches promptly read. It passed overhead or nearly so at several points from Deerfield to Holyoke and Mt. Holyoke College ; the mean of the final bearings at Mt. Holyoke College is S 26° E. There are no good cross-bearings to combine, and consequently such altitudes and durations as are given fail to be useful ; but of the separate identity of the meteor there is no doubt.

The meteor is described as follows :

Deerfield ; distinctly green.

Holyoke (anon.) ; a very bright purple or blue . . . not so fast.

Mt. Holyoke College (Miss B.B.) ; brightness compared to moon. It seemed to get brighter and larger at end of trail. It seemed to disappear right in mid-air.

Mt. Holyoke College, (anon.) ; brightness of a full moon . . . color of yellow fire, and left a trail.

Mt. Holyoke College, (Miss R.A.) ; not so bright as a full moon, but more like a brilliant sky rocket ; greenish blue.

Worcester ; a clear head of white which instantly merged into the ball

of red flame, and this was succeeded by a splendidly widening tail . . .

Allston; far larger and brighter than any I have ever seen.

South Weymouth; large meteor of a beautiful shade of light blue, ranging towards a yellow, and the flames seemed to actually burst from it . . . not much tail . . . very much slower than any other meteor I have ever seen. No clouds visible.

Boston; moved very rapidly; rather a bluish green color . . . with a tail of fire . . . likened to a ball from a Roman candle, though much larger and brighter.

M.A.C. Campus, Amherst; brilliant, bluish.

The varied descriptions of meteors (1) and (2) show that little reliance can be placed on statements about color and form, for purposes of identification of meteors. One has to rely on observed time of apparition and geometrical data. These are unfortunately often so vague that nearly simultaneous meteors cannot be distinguished easily and certainly.

(3) Quincy (Germantown), Mass.; Mrs. B. D. Hoxie; 4:45±; a pale yellow sunset sky, not a cloud visible . . . a brilliant star flashed over my head . . . and appeared to vanish just over the river [Weymouth Fore River]; a long trail of radiant silver and red, like a flame, behind it . . . it seemed so low, just over the trees and river, when it disappeared.

Jamaica Plain, Mass., E. H. Cooke; 4:30 to 5:00; saw it at about 90° up in the sky . . . when about 30° up from the plane of the horizon the ball of light . . . went out . . . travelling from NW towards SE . . . sky was clear, no clouds . . . very dazzling . . . [like] the light from a soft piece of steel when welding by electricity . . .

These two reports indicate a bright meteor passing over the Boston region; there seem to be no other observations readily referable to this.

(4) Chester, Mass., D. T. Donelly; 4:45 to 4:50, determined from the leaving of a railway train, on time, at 4:55, about 10 min later. Initially a little N of the zenith, passing "directly above Chester, not a whit to the E or to the W." In a second letter, "this is the one point on which I am sure. It was directly over me, going N to S." This bearing "may have varied as much as 30°". The fadeout was sudden . . . about 30° above the horizon . . . the meteor retaining its brightness to the end.

This may be a lone observation, or the following may correspond to it:

Hadley end of the bridge, Northampton to Hadley, Mass., Miss M. Williams and Miss C. Guiler, Instructors in Astronomy, Smith College, Northampton; "we noted its position with relation to a bridge on which we were standing, and later returned, when the stars were shining, to determine the altitude and azimuth. Positions: initial, S 45° W + 10°; final, S 10° W + 40° or 45°; duration 1 or 2 sec. Brighter than Venus, intense greenish blue color . . . leaving a trail, the ball itself bursting, not large, but very bright."

On account of the uncertainty of the vertical plane of motion as seen

at Chester, not much can be done with these observations. The bridge observations might be applied to meteor (1), but they give a length of path much too small, and heights much too large to agree with other observations on (1). They can hardly be applied to (2), as this bridge is nearly under the path of (2). Of course, the bridge observations may refer to a meteor not otherwise observed.

(5) Somerville, Mass., James Ginnane; about 4:20; standing outside Ford's new plant to see a friend . . . about twenty minutes past four o'clock . . . looking towards West Somerville, or, to be more exact, towards Winter Hill direction . . . a large shooting star, passing towards the earth. Its brilliance . . . far exceeded any that I have ever seen . . . more than 18 years. When first observed it was not so bright . . . Tail or sparks large. Sky clear. Instantaneous disappearance.

The Ford Motor Co., in reply to direct inquiry, write that their plant closed at 4:20 P.M. on the afternoon of November 19. Sunset came at about 4:20, E.S.T., by the American Nautical Almanac.

This seems to have been a lone observation.

(6) Portland, Me., tower 3, Portland Terminal Co., D. L. Murphy, telegraphist in this tower; 4:42; falling nearly straight down; from sketch of floor plan, windows, compass points, and direction of meteor, N 9° E. Weather clear, calm. Meteor very unusual—more like a ball of fire, and dropped [in an undulating path, by sketch].

This seems to have been a lone observation.

Following are reports relating to observations about 4:30:

Amesbury, Mass., driving on Southampton road, A. L. Rundlett; 4:30±; meteor travelling very fast, almost N to S, bearing a little toward SW; tail beautiful shade of greenish blue . . . two if not three stars thrown from it . . . These stars snapped for a moment or two in a beautiful blue and green color.

Lyndhurst, N. J., D. Exler, pupil in Lyndhurst High School; 4:30±; two letters, one in reply to queries. (a) Was playing football; bright, sunny day; was looking toward that part of the horizon . . . there was a long stream of fragments following the meteor which looked like sparks . . . several large pieces were following very closely; these large pieces were about one fourth as large as the meteor itself; the fragments toward the end of the line were much smaller; these fragments were visible for a short time, possibly for a fraction of a second, after the meteor itself became invisible; it was exceedingly bright.

(b) The sun was shining at the time, it was a very clear day; the sun was rather low in the west, because it happened about 4:30 P.M. . . . I went back to the place where I was standing and judged the direction . . . training in scouting. Positions: initial, NEbE, halfway from zenith to horizon; final, EbN, nearly to horizon. Course toward E. Bearings magnetic.

[At Lyndhurst, by atlas map and the American Nautical Almanac, sunset was at about 4:36, E.S.T.]

North Adams Airport, 2 miles due west of North Adams, Mass., W. Van Benschoten; nearer 4:30 than 4:45; Positions; initial, not more than 10° E of S, by compass, altitude about 45°; final, behind the mountain; course E to W; duration about 3 sec. A curving arc bending toward the earth . . . travelling toward the E, until it disappeared behind the mountain. First seen probably long after it appeared.

Towaco, N. J., Mrs. L. C. Roberts; about 4:30. (This place is said to be the same as Whitehall of the atlas maps.) After the observations the following positions were obtained, using an inch scale about 26½ inches from the eye: initial, 12 inches E of Polaris = 24⅓°; final, 28 inches E of Polaris, = 46½°; path seemed to be a straight line parallel to the horizon, 7 inches or 14°.8 below Polaris, *i.e.* about 26° altitude. The head was yellow, the tail like sparks in electric arc welding. No noise, but a football game was in progress.

Towaco, N. J., Rev. H. Hinrichs, observations mentioned above in connection with (1).

This group of observations presents certain difficulties.

The Towaco observations of Mr. Hinrichs are not reconciliable with the others, but go best with (1), if an error of 15 min in time is admissible.

The Towaco observations of Mrs. Roberts cannot agree with the Amesbury observations, but the Lyndhurst observations might. The distance from Lyndhurst to a conceivable point on the sub-path of a meteor going nearly S from Amesbury being over 200 miles, the actual initial height of the Amesbury meteor would be much over 200 miles = 320 km, which is improbable. In the Catalogue of 611 Great Fireballs hardly any initial heights equal 300 km. It is not likely that the Amesbury meteor was observed at Lyndhurst or Tawaco.

Using a sub-path bearing magnetic S 10° E from North Adams, and computing heights for the Towaco and Lyndhurst observations, we have

	Altitude	Distance	H	Bearing
Towaco initial	26°	145 mi	71± mi	N 24° E
Towaco final	26	109	53±	N 47° E
Lyndhurst initial	45	100	100±	NEbE magn.
Lyndhurst final	10±	92	16±	EbN magn.

The sharp break between final H for Towaco and initial H for Lyndhurst indicates that the two series cannot be reconciled. Nothing can be done beside placing the observations on record.

Numerous other reports received seem to be unusable, because, on account of vagueness or unfortunate positions of observers, they cannot probably be assigned to any of the groups above. The data in general are so rough that exact plotting and computation are not justified in dealing with them. They are, however, very good for a sky that was still bright with sunset glows, so bright that no stars were yet visible for markers.

It would seem that the newspaper dragnet, cast over an area of dense

population like New England and the Hudson Valley, is likely to produce observations of nearly simultaneous meteors no two of which are reported by any one observer.

It is possible that, among the meteors of November 19, those of Hurley, Holyoke, and Quincy were nearly parallel in paths. No conclusion of any value can be drawn about the others. None of them descended so low as to produce detonations, and hence there is no likelihood that stones fell from any of them to the ground.

What Constitutes Reliable Data Regarding Meteors or Fireballs?

By H. H. NININGER

It has long been recognized that observations upon large meteors or fireballs can yield valuable information regarding the orbits by which meteorites reach the earth. During the past ten years the writer has been involved in the investigation of a number of such meteors and in the process of carrying on these investigations has experienced a growing skepticism concerning the reliability of certain methods commonly used in the securing of the data which are usually published descriptive of such events.

In order to present the case clearly, I shall begin by relating the ascertained facts concerning the great daylight meteor of February 26, 1931. At about 10:30 A.M., Central Standard Time, on the date mentioned, observers throughout Colorado, Kansas, and Nebraska witnessed one of the most remarkable meteors that have been recorded in this part of the world. In an attempt to locate this new visitor to our planet, the writer, in collaboration with the Colorado Museum of Natural History, spent several months carrying on an extensive correspondence and traveling several thousand miles, obtaining data by personal interviews, until it seemed nothing more could be done; and although the search has thus far proven fruitless so far as the recovery of the meteorite is concerned, it appears that something of scientific value may be gleaned from a review of the facts connected with this event.

Briefly summarizing the facts gathered during those months of effort we may safely conclude that on February 26, 1931, at about 10:30 A.M., C.S.T., a meteorite descended from the northeast at an angle of about 40 degrees with the horizontal, producing during the latter third of its visible course a dense column of bluish-gray dust ("smoke") about 400 feet in diameter as formed and about 16 to 20 miles in length. The dust cloud ceased forming and the meteor vanished from view at a point about 8 to 10 miles above the soil, 6½ miles south and 1 mile east of Bird City, Rawlins County, Kansas.

The usual detonations were heard to distances ranging from 20 to 50 miles in various directions from this location, and at points to the westward whizzing sounds as of flying missiles were heard. Antecedent to the production of the dust column, the meteor was observed as a fireball throughout about 40 miles of its course. After its formation, the cloud gradually widened and thinned, disappearing as it drifted northward with the wind.

The dimensions and distances given above were arrived at by taking the averages of reports received in personal interviews from some forty selected observers distributed on all sides of the place of fall, registering their memories of the event on a Brunten Compass and Altitudometer, and reducing these records to miles and kilometers. While no fine degree of exactitude can be claimed for these figures, yet they can be relied upon as sufficiently accurate for a general understanding of the location, direction, and magnitude of the phenomenon.

While working on the above case, the uselessness of certain methods of gathering data on fireballs was so forcibly and finally impressed upon the writer that he wishes here to put them on record.

By the very nature of the case it becomes necessary in many instances to depend entirely upon untrained observers for the information desired; and even in cases where one or more trained individuals have witnessed a fall, much valuable information can be added by laymen if the investigator can know how to sort out and evaluate their reports.

We can readily see that the ideal condition would be to have two or more trained astronomers with suitable instruments to make reliable observations, and from these deduce all of the desired facts. But if we must wait for these conditions to be fulfilled in a sufficient number of cases to represent all of the various situations, then conclusions in the realm of meteoritics will be postponed for at least a few millenniums, for it must be admitted that down-to-date, meteorites have been very reticent about announcing in advance the time and place of their arrival.

After all, the general public is capable of furnishing considerable valuable information if we can learn how best to utilize what it is able and willing to give; but if we expect a layman to render his contribution in the language of science, then we are surely going to be mistaken or disappointed.

Not long since, I read an account in one of the astronomical journals of a meteor which fell in Idaho December 24, 1930. This account presumed to describe the orbit and to give the location of the fall with a fair degree of accuracy—at least worthy of being placed on record. The writer of that account is an astronomer of good standing and, I have no doubt, meant to be reliable. Yet in this instance his conclusions were badly in error, both as to location of the fall, and the path of the meteor.

The writer spent a week personally interviewing witnesses to this Idaho meteor in the respective locations from which their observations had been made. I found a very satisfactory agreement among their

various reports and determined upon a reasonably definite location of its landing place as well as its path through the atmosphere, but my conclusions were widely at variance with those of the astronomer referred to, who remained at his office, depending upon written communications for his data.

An example from my own experience will serve to make clear my reason for considering the written reports by laymen entirely unreliable. While investigating the fall of February 26, 1931, a letter was received from a merchant who observed the fall from a distance of about 80 miles. The letter was accompanied by a very well executed drawing of the smoke cloud left in the wake of the meteor. The language used in the letter was far above that of average laymen, and it was selected as one coming from a careful observer whose observation could be used to advantage. I wrote him, asking that he amplify his description by giving an estimate, in degrees, of the altitude of this cloud. His reply was that as nearly as he could estimate, without any instrument for measurement, the cloud was at an altitude of about 75 degrees. This was so completely out of harmony with what I had already learned from persons who had pointed out what they saw from the spots where the various observers had stood, that I wrote him again, reminding him that the distance from the horizon to the zenith ("the point directly above him") was 90 degrees, and asking him to check very carefully his estimate. Again I received a good letter with a drawing like the first, and he reassured me that a careful re-checking convinced him that he could not do better than to place the altitude at 75 degrees.

By this time, I had accumulated abundant evidence from personal interviews as to the altitude of the cloud and determined to visit this informant in order to clear up the inconsistency. When asked to look through the altitudometer at the point in the sky where he had seen the cloud, he moved with the precision of an experienced scientist, carefully studied the landscape and the sky, and finally gave me two readings which were both between 10 and 11 degrees above the horizon! This was in harmony with the established location. Aside from the wretched discrepancy between his correspondence and his oral testimony, I was able to discover no indication that this man was other than the ultra-reliable man that his neighbors had described him as being.

The foregoing is one of the many experiences which have finally convinced me that the only data worth recording from laymen are those secured by personal interview on the spot from which the observations were made. So many instances comparable to that just cited have been met with in my experience that I have come to place no dependence in any published description which is known to be based only upon correspondence from untrained observers.

I believe that before reports of amateur workers can be taken seriously, there should be an arrangement whereby a trained observer in each locality should edit all reports and, where possible, record their observa-

tions in a personal interview with each observer on the spot from which the observation was made.

In my own work, I have come to use the medium of the mails merely as a means of locating desirable witnesses which may later be interviewed. This makes the survey of meteoric falls much more expensive; but in my opinion one fall so investigated is of more value than a dozen surveys which have depended upon the written data furnished by laymen.

The personal interview also permits of the elimination of reports furnished by individuals who, in a personal interview, quickly reveal their inability to make careful observations, but who may write out a fairly convincing account.

COLORADO MUSEUM OF NATURAL HISTORY, DENVER, COLORADO.

The Maria Mitchell Observatory Eclipse Expedition of 1932

By MARGARET HARWOOD

Since Nantucket lay fifteen miles outside of the southern boundary of the path of totality, the Maria Mitchell Observatory had three alternatives in picking a station: to sail into the path on August 31 and to observe the eclipse of the sun from a boat; to join one of the many large eclipse camps which were concentrated near the center of the path in Maine, New Hampshire, and Vermont; or to establish our own expedition on the northeastern part of Cape Cod, forty miles southwest of the central line. In spite of a strong desire for the second, we chose the last of the three possibilities, for we realized that the uncertainties of weather might prove it to be advisable for one expedition to be located as far southeast as possible from the others. And to a certain extent the Cape seemed to be our province and responsibility. No other observatory planned to go there.

The region near Cape Cod Light, popularly known as Highland Light, in North Truro, afforded the longest duration of totality of all places on the Cape and also it promised the best weather conditions. A prevailing southwest wind often dispels the fog which frequently hangs over other parts of the neighboring coast. Almost immediately after the locality for our station was decided upon, there came an offer from Mr. H. M. Aldrich of Boston giving us the use of the embattled tower which stands on the wooded hill known as Red Top, one mile southeast of Highland Light. This tower, once one of the stone towers of the old Fitchburg Railroad Station in Boston, was bought by Mr. Aldrich, when that old landmark was demolished in 1928, and removed to its present position, where it makes an ideal observatory; it is fifty-five feet high and it stands, about one hundred yards from the outside shore, on a hill

which is one hundred and ninety-five feet above sea level. The top of the tower, which is forty-five feet higher than Highland Light, commands an almost complete sea horizon.

Inside the tower, the space at the foot of the spiral staircase was easily converted into a photographic dark room.

In addition to loaning us their land and tower, and showing us many other courtesies, Mr. and Mrs. Aldrich gave us the use of a furnished cottage, named Neptune, where we could sleep and eat.

FIGURE 1.
ALDRICH TOWER.

The personnel of the expedition was as follows: Margaret Harwood, Marjorie Williams, and Edgar F. Sanborn, Jr., of the Observatory; Alexander E. Hoyle, a member of the firm of Cram and Ferguson, architects, Boston; Gerald M. Reed, Jr., of Nantucket, a navigator; Merle E. Turner of Nantucket, a Junior in Wheaton College; Samuel N. Aldrich, a student in the Harvard Law School and the son of our benefactor; Werner A. Ericson of New York, a summer resident of North Truro. On the day of the eclipse we were joined by the President of the Nantucket Maria Mitchell Association, Mrs. Francis W. Davis, her son, Nathan Cushing Davis, of Belmont, Massachusetts, and

Nantucket, Mrs. C. Russell Hinchman of Philadelphia, Mr. Albert G. Brock, President of the Pacific National Bank of Nantucket, and Mr. Harry B. Turner, editor and owner of the *Inquirer and Mirror,* the weekly newspaper of Nantucket.

Our equipment included three visual and two photographic telescopes. A Ford suburban automobile, loaned by Mr. and Mrs. H. Eskildsen Moller, was useful for transporting luggage and apparatus from Nantucket and for covering distances on the Cape. Miss Williams was the driver. One of the portable visual telescopes, of two and one-half inches aperture, stood near Highland Light. It was used by Cushing Davis, aged nine years, to project the image of the sun on a screen for the benefit of the many hundreds of persons who were assembled near the Light House to observe the eclipse. The other two visual telescopes, of three, and three and one-half inches aperture, respectively, were placed on the ground near the base of Aldrich Tower. They were used by Mr. Brock and Miss Harwood to observe the eclipse including the timing of the second and third contacts.

The two photographic telescopes were stationed on the top of the Tower. One of these, a 4-inch Voigtländer camera of the portrait type with its mounting, was borrowed from the Harvard Observatory in order that direct photographs could be made which could be used to study the distribution of light in the corona in the same way as we did at the eclipse of January 24, 1925 (See *H.C.* 312). This telescope was operated by Miss Williams assisted by Miss Turner and Mr. Aldrich. The other instrument on the Tower was Harvard coronal photometer "C", one of the four similar pinhole cameras which were designed by the late Professor E. S. King and used in the 1925 eclipse to measure the total brightness and the color of the corona (*H.C.* 286). We undertook this work for the Harvard Observatory; the other three photometers were stationed at Gray, Sanford, and Douglas Hill, Maine. Instead of the yellow filter used in former eclipses, Dr. Whipple installed red filters in all of the photometers: Wratten Light Filter No. 28, Cine Red. For red sensitive plates Wratten Wainwright Hyper Pan plates were used; for the blue light: Seed Process plates. Four exposures with photometer C were made; it was operated by Messrs. Sanborn, Ericson, and Hoyle.

As soon as she observed the last one of Baily's Beads disappear from view, Miss Harwood gave the signal that totality had begun. From the top of Aldrich Tower Gerald Reed called off seconds to the beat of a metronome, and the operators of the two telescopes began their work. The program was so arranged that each operator was free to observe the total eclipse for himself for at least twenty seconds.

At the time of the eclipse the sky was not as transparently clear as we had hoped. There had been hot, sultry weather for two days. Thin cirrus clouds covered the sky with varying intensity throughout the day of August 31. These interfered with the accurate observation of the first contact, but with this exception, all other phenomena of the eclipse

appeared vividly clear. The brilliancy of the corona prevented the clouds from being evident to the eye, but the photographs show that there was very little clear sky in the immediate vicinity of the sun. The corona with long, well-defined streamers comes out distinctly on all of the plates, and yet there is grave doubt as to whether there is a sufficient background of clear sky to yield accurate results from measurements of the distribution of light.

The aperture of the Voigtländer telescope is four inches; the focal length, twenty-four inches. The plates were exposed one, two, five, and three seconds, respectively. Cramer Hispeed plates were used. They

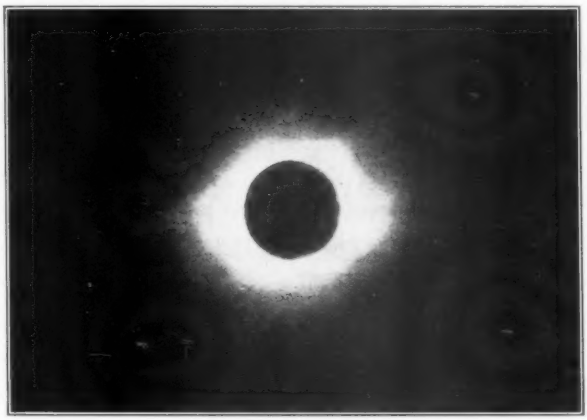


FIGURE 2.
SOLAR CORONA AND THIN CLOUDS PHOTOGRAPHED FROM ALDRICH TOWER.

were backed with a solution of burnt umber and glucose. The diameter of the image of the moon is six millimeters. Coronal streamers in the northeast, northwest, and southwest quadrants can be followed for a distance of ten, five, and seven and one-half millimeters, respectively. In other words, they extend out at least 1,440,000, 722,000, and 1,080,000 miles from the surface of the sun. Corresponding streamers are the same length on the plates of two, three, and five seconds' exposure. On the plate which was exposed one second the streamers are a little shorter.

The photometer plates prove also that scientifically the clouds were a hindrance. All of the three images made in blue light on each plate are distinct, although less intense than those made under a clear sky at Gray, Maine. The images on the red sensitive plates made at Gray are visible, though very faint, but on the plates made at North Truro, they are not even discernible.

The observations of the contacts and the predicted Eastern Standard Times, computed at the U. S. Naval Observatory, are given in the following table. The fourth contact was observed without the aid of a telescope. A deep valley on the moon near the point of second contact, caused the total phase of the eclipse to appear to arrive late. Mr. Brock reported that he was conscious of being one or two seconds late in manipulating the stop-watch when he recorded the third contact.

Aldrich Tower, Red Top Hill, North Truro, Cape Cod.
Longitude: 70° 03′.38 W; Latitude: +42° 02′.04.

Observer	Telescope	Contacts 1	2	3	4
			h m s	h m s	
Harwood	3½-inch		3 33 09.6	3 34 10.8	
Brock	3-inch			3 34 12.3	h m s
Harwood					4 36 42
Turner					4 36 49
Williams		h m s			4 36 48
Predicted		2 24 17.2	3 33 01.8	3 34 09.1	4 37 26.0

On the nights of August 27, 28, and 29, aurora of the curtain type was visible at North Truro in the north and northwest. Upon examining the surface of the sun with the 3-inch telescope we noticed, in addition to one small sunspot near the center of the disk, extensive patches

FIGURE 3.
MID-ECLIPSE AT NANTUCKET,
taken by Alvin E. Paddock at the Maria Mitchell Observatory.

of faculae which would be near the limb on the day of the eclipse. These latter were indicative of the scarlet prominences and bright whitish patches which became visible during totality in the northeast and northwest quadrants. The corona was of the type usually associated with sunspot minimum and yet it seemed exceptionally brilliant. During totality the planet Jupiter was the only other celestial object visible at North Truro. Clouds concealed Mercury and Regulus.

From the ocean, not many miles away, members of a sailing party from Nantucket observed Regulus and both planets. Two interesting observations made by passengers of this boat, the "Mary," are as follows: Miss Grace Wyatt, botanist of the Maria Mitchell Associa-

tion, saw the coronal streamers before the last bit of the sun's crescent disappeared; Miss Elsie M. Paine of Cambridge, Massachusetts, saw the corona sixteen seconds after she observed the first return of sunlight.

On Nantucket Island, where ninety-nine per cent of the sun's diameter was covered by the moon, there was considerable cloudiness. The moon's shadow was observed to pass from the north to southeast with a well-marked boundary line reflected in the water. Shadow bands were seen on the sand both at Pocomo Head and at Wauwinet, while on Quarter Mile Hill in the town of Nantucket, nine miles farther west of the central line, the bands were looked for but not seen. At this place the temperature in the shade fell from +76° F at 2:45 E.S.T. to +70° at 3:35 (mid-eclipse). At 4:15 it had risen again to +74° F. A thermometer in full sunlight was +100°.5 at 2:45, at mid-eclipse it registered +68°.5. At 4:15 it had risen to +83°.5 F.

Maria Mitchell Observatory, Nantucket, Massachusetts.

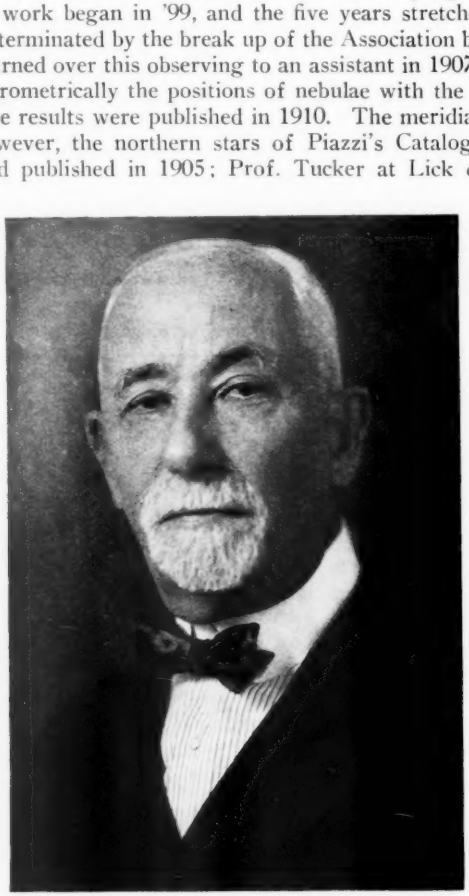
Jermain G. Porter
(1852-1933)

By EVERETT I. YOWELL

In the death of Dr. Jermain G. Porter on April 14, we have lost a prominent member of the older school of astronomers. Son of Rev. John Jermain and Mary (Hall) Porter, he was born in Buffalo in 1852 and graduated from Hamilton College in 1873. At Hamilton he studied under the brilliant C. H. F. Peters, of whom it was said that he knew more Greek than the Greek professor, and more Latin than the Latin professor. After a year's work under Foerster at Berlin, Porter returned to Hamilton as assistant professor of astronomy. He received his M.A. in '76 and two years later went to Washington to the Coast and Geodetic Survey. Six years were spent there, his marriage to Emily Snowden occuring in '79; they lived happily to celebrate their golden wedding in their home adjacent to the Observatory Grounds. When Ormond Stone was called from Cincinnati to the Leander McCormick Observatory of the University of Virginia, his assistant, H. C. Wilson, remained in charge until the appointment of Dr. Porter as Director in 1884. His services at the Cincinnati Observatory thus cover more than half of its history.

He found the Observatory equipped with the 11-inch refractor, 3-inch transit instrument, and portable 4-inch Clarke refractor. With the transit circle he observed the Zone Catalogue of 4000 stars, and found the right ascensions fair, but the declinations unsatisfactory. So the meridian circle was acquired in 1888 and with it he did most of his work. A decade of observing gave three catalogues of star positions and pro-

per motions, published in '92, '95, and '98. Then he agreed to coöperate with the International Geodetic Association in the Variation of Latitude work, and bound himself to follow their program for five years. The work began in '99, and the five years stretched to fifteen years, being terminated by the break up of the Association by the World War. He turned over this observing to an assistant in 1907, in order to measure micrometrically the positions of nebulae with the new 16-inch telescope: the results were published in 1910. The meridian circle was not idle, however, the northern stars of Piazzi's Catalogue were reobserved and published in 1905; Prof. Tucker at Lick observed the



JERMAIN G. PORTER, 1852-1933.

southern stars of that catalogue. In 1915, '16, '17, and '18 were published the four parts of a catalogue of proper motions, and in '22 the positions determined with the meridian circle. His last work, stars with large proper motions, appeared in 1930 after his retirement.

My own acquaintance with him began when he came to Cincinnati, for our home is only half a mile from the Observatory. In '95 he asked

me to take charge of visitors, as he wanted his nights free for observing; I remained his assistant up to his retirement, except for eight years spent in the East. Professor Porter was interested in the older lines of work, and as more astronomers devoted their time to astrophysics, he felt it was of vital importance that the older lines of work should not be abandoned. He received the honorary degrees of Ph.D. from Hamilton in 1888 and Sc.D. from the University of Cincinnati in 1930. In 1894 the *Astronomical Journal* prize for comet observations was awarded him; he told me once with a chuckle that he had constructed his own micrometer. He was a member of Phi Beta Kappa, a charter member of Cincinnati chapter of Sigma Xi, and belonged to the Washington Academy of Sciences as well as the American Astronomical Society.

Stephen Crasco Hunter

By WILLIAM TYLER OLCOTT

With the passing of Stephen Crasco Hunter, aged 72, whose death occurred in Miami, Florida, on March 27, 1933, the cause of amateur astronomy lost an ardent supporter, and the American Association of Variable Star Observers an esteemed and loyal member.

Mr. Hunter was for many years a partner in the firm of Johnson and Higgins, Marine Brokers, in New York City. He retired from business in 1918, and travelled extensively all over the world.

Always keenly interested in astronomy, he was one of the seven individuals who met in New York City, on April 8, 1911, and organized the American Association of Variable Star Observers.

In the grounds of his home in New Rochelle, New York, he erected a splendid observatory in which he mounted an 8-inch Alvan Clark refractor, and engaged in the observation of long-period variable stars.

Mr. Hunter was a Life Member of the A.A.V.S.O., served on the Council in 1921, and attended many meetings of the Association. He maintained an active interest in the work of the Association during the latter part of his life, even making observations up to within a few days of his death. Ill health for many years and absence from home sadly interfered with a work he was deeply interested in.

He lectured frequently on astronomy in the public schools of New Rochelle, and vicinity. A great student of the Bible, he was particularly interested in the astronomical references in Holy Scripture.

Naturally reserved in manner, his life was wholly devoted to his family. His son, Mr. Francis T. Hunter, was second ranking tennis player in this country for several years, and Mr. Hunter took a keen interest in the sport.

For many years Mr. Hunter was actively interested in yachting and participated in many races on Long Island Sound. His home was filled with trophies won on these occasions.

Mr. Hunter was particularly interested in the subject of the personal equation of variable star observers. As an indication of his interest in the subject of variables the following is quoted from an article published by him:

"It is a great game anyhow, and has a peculiar charm which can scarcely be explained to the uninitiated. Even after years of observing, the spectacular and adventurous character of the work still exercises a strong appeal. That tiny bright speck of varying hue and brilliancy, which must be accurately spotted amid the diamond dust of space, may be an immense fire-orb in some mysterious stage of activity that for size and power far outstrips our own life-giving sun. The very thought of locating and studying the changeful phenomena of such an object is indeed enough to stimulate the most sluggish imagination."

A New Method of Making Replicas of Diffraction Gratings*

By ERNST KEIL

Diffraction gratings are costly and extremely delicate instruments and as there are very few machines in existence which produce them they are even more rare than costly. But they are indispensable for certain kinds of spectroscopic investigations and ever since their appearance a good deal of time and ingenuity have been expended in attempts to develop a method by which replicas or copies of diffraction gratings may be made. However, so far none of these attempts have been entirely successful and that for two reasons namely, *i.e.* either the method employed was too complicated to be practical or the replicas produced did not measure up to the strict requirements they must meet to be considered for serious scientific work.

The method most commonly used for making such replicas is as follows: A grating is carefully levelled, a solution of celluloid or collodion is poured over it and allowed to dry. The grating with the celluloid film adhering to it is then immersed in water and after having become thoroughly water-logged the replica may be peeled off the grating. It is now, usually still under water, transferred to a piece of optical glass onto which it is gently pressed and patted until all traces of water and air are expelled from between glass and replica. Replicas so prepared are very beautiful things to look at or to play with and they may be used for illustrating and demonstrating the principles of spectroscopy but, unfortunately, for serious scientific work they are seldom good enough, not even in transmitted light.

The shortcomings of this process are obvious and the most objection-

*Laboratory, Technical Products Company, Inc., Los Angeles, California.

able one is undoubtedly the water-logging of the delicate film which contains the grooves of the grating. It requires a delicate touch, unlimited patience and superhuman optimism to hope that the film, when finally mounted on a piece of optical glass, will still be a faithful reproduction of the 15,000 lines per inch of the grating, straight, evenly spaced and flat within a small fraction of a wave-length of light.

The writer has been keenly interested in spectroscopic work as an amateur for many years and a good deal of his practical information and experience has come to him through the kindness and the fine spirit of coöperation of his friends and acquaintances at the Mt. Wilson Observatory where he served at one time as instrument maker. During the last three or four years he has devoted a good deal of thought to the development of a process for the production of replicas that could be used, like gratings, in reflected light. These replicas were to be made of some organic substance, not necessarily celluloid, and then covered with metal. As peeling under water, due to its obvious shortcomings, was out of the question the first part of the problem, *i.e.* the making of the replica proper required first: a substance that will dry in a smooth, homogeneous film which can be peeled off the grating without using water or any other liquid. Second: means of holding the replica during and after peeling so that it will remain as truthful a reproduction of the grating from which it was made as that is possible.

After a long series of experiments with various lacquers, gums, and other similar materials several substances were found that answered to a greater or lesser degree the first requirement, *i.e.* peeling without using water or any other liquid. Although hundreds of sample specimens have been peeled to date no definite decision as to which of the lot is the most suitable has yet been reached. Further experimental work is in progress with the object of determining the unquestionably best.

The second requirement, that of providing means for holding the replica during and after peeling was finally solved in a very simple way. A frame of sheet celluloid, its inner dimensions slightly larger than the ruled area of the grating, was clamped onto the grating. After levelling, the grating area encompassed by the celluloid frame was filled with the solution which in drying forms the replica. As this solution contains a certain amount of Amyl Acetate (a solvent for celluloid) it is, during the process of drying, united with the celluloid frame and forms one homogeneous element with it. The replica, securely anchored to its frame, may now easily be peeled off the grating "as is." The largest replica the writer has so far peeled by this process measures 3x2.5 inches. By this same method transmission gratings in round celluloid frames of ⅝-inch and 1-inch clear aperture and 1-inch and 1⅜-inch outside diameter, respectively, have been peeled by the writer and used with excellent results in small direct vision spectroscopes.

The work of covering the replicas with metal and mounting them on optically flat supports is still in the process of development and will be

published as soon as tangible results are available. The remarkable success of Dr. Strong of the California Institute of Technology and Dr. Edwards of the University of California at Los Angeles in producing aluminum-magnesium mirrors of unusually high and uniform reflecting power throughout the visible region of the spectrum with the so-called evaporation method suggests very interesting possibilities for the making of reflecting replicas. The number of metals that can be deposited by this now highly perfected method of evaporation will make it possible to cover replicas with a great variety of reflecting surfaces, such as gold, silver, platinum, aluminum, aluminum-magnesium, nickel, and many others. Thus an investigator may cover a replica with a material that will give him higher reflecting characteristics over a selected wave-length range than he could get with the speculum metal on which the grating is ruded.

Planet Notes for September and October, 1933

By CLIFFORD E. SMITH

The *Sun* will be moving southeast from the central part of Leo to the eastern part of Virgo. The distance of the earth from the sun on September 1, will be about 93.7 million miles, and this distance will decrease to about 92.4 million miles by the end of this period. On September 23 at 6:00 A.M., C.S.T., the sun will be at the autumnal equinox which marks the beginning of fall. The position of the sun on Sept. 1, Oct. 1, and Oct. 31 will be, respectively: R.A. $10^h\ 39^m$, Decl. $+8°\ 32'$; R.A. $12^h\ 27^m$, Decl. $-2°\ 55'$; and R.A. $14^h\ 19^m$, Decl. $-13°\ 54'$.

The phenomenon of the *Moon* will occur as follows:

Full Moon	Sept.	3 at	11 P.M.	C.S.T.
Last Quarter		11 "	4 P.M.	"
New Moon		19 "	12 M.	"
First Quarter		26 "	10 A.M.	"
Full Moon	Oct.	3 "	11 A.M.	"
Last Quarter		11 "	11 A.M.	"
New Moon		18 "	12 P.M.	"
First Quarter		25 "	4 P.M.	"
Apogee	Sept.	12 "	3 A.M.	"
"	Oct.	9 "	11 P.M.	"
Perigee	Sept.	25 "	4 A.M.	"
"	Oct.	21 "	6 P.M.	"

Mercury will be moving with an apparent southeasterly motion from the central part of Leo, across Virgo, to the eastern part of Libra. During September it will be near the sun in apparent position since superior conjunction will occur on Sept. 11 at 6:00 P.M., C.S.T. Greatest elongation east, however, will occur on October 28 at 4:00 A.M., C.S.T., so that at the end of this period Mercury will set about an hour and a half after the sun. On Oct. 31 Mercury's distance from the earth will be about 90 million miles, and its apparent diameter will be about 7 seconds of arc. On Sept. 20 at 5:00 A.M., C.S.T., and on Oct. 20 at 5:00 P.M., C.S.T., Mercury will be in conjunction with the moon (Mercury 4°5 and 2°7 N, respectively). On Sept. 19 Mercury will be in conjunction with Jupiter at 1:00 A.M., C.S.T. (Mercury 0°05 S).

Venus will be moving with an apparent southeasterly motion from the central part of Virgo, across Libra and Scorpio to southern Ophiuchus. Its distance from the earth will decrease from about 120 million miles to about 80 million miles, while the apparent diameter will increase from about 13 to about 19½ seconds of arc. Venus will be a brilliant evening star during this period and it will set about 2½ hours after the sun. Conjunction with the moon will occur on Sept. 22 at 4:00 P.M., C.S.T., and on Oct. 22 at 7:00 A.M., C.S.T. (Venus 4°.3 and 2°.4 N, respectively.) On Oct. 12 at 2:00 P.M., C.S.T., Venus will be at aphelion, and on Oct. 14 at 6:00 A.M., C.S.T., Venus will be in conjunction with Mars (Venus 1°.2 S.).

Mars will be moving with an apparent easterly motion from the western part of Libra to the eastern part of Scorpio. At the beginning of this period its distance from the earth will be about 170 million miles, and this distance will increase about 20 million miles. Its apparent diameter at the beginning of the period will be about 5 seconds of arc, and this will decrease about ½ second of arc by the end of this period. Mars will be in conjunction with the moon on Sept. 23 at 9:00 A.M., C.S.T., and on Oct. 22 at 1:00 A.M., C.S.T. (Mars 4°.6 and 4°.0 N, respectively). A conjunction with Venus on Oct. 14 has been mentioned in the notes on Venus. During the middle of this period Mars will set about three hours after the sun.

Jupiter will be near the sun in apparent position in western Virgo. Conjunction with the sun will occur on Sept. 26 at 12:00 P.M., C.S.T., but, by the end of this period, it will be a morning object, rising about two hours before the sun. A conjunction with Mercury on Sept. 19 has been mentioned under Mercury. Conjunction with the moon will occur on Sept. 20 at 2:00 A.M., C.S.T., and on Oct. 17 at 10:00 P.M., C.S.T. (Jupiter 4°.5 N. in each case).

Saturn will be in central Capricornus. At the end of October it will be near quadrature east and thus at that time it will be near the meridian at sunset. Its distance from the earth will be about 875 million miles, and its apparent diameter will be about 16 seconds of arc. Saturn will be in conjunction with the moon on Sept. 1 at 7:00 P.M., C.S.T., on Sept. 28 at 12:00 P.M., C.S.T., and on Oct. 26 at 6:00 A.M., C.S.T. (Saturn 0°.65, 0°.70, and 0°.50 N, respectively).

Uranus will be in eastern Pisces, and it will be visible most of the evening hours since it will be at opposition with the sun on Oct. 18 at 12:00 P.M., C.S.T. The distance of Uranus from the earth will be about 1790 million miles, and its apparent diameter will be about 3½ seconds of arc. Uranus will be in conjunction with the moon on Sept. 7 at 2:00 P.M., C.S.T., and on Oct. 4 at 8:00 P.M., C.S.T. (Uranus 5°.5 and 5°.4 S, respectively).

Neptune will be in conjunction with the sun on Sept. 2 at 4:00 P.M., C.S.T., and thus it will be too near the sun in apparent position to be of interest during this period.

OCCULTATION PREDICTIONS

(Contributed by the office of the *American Ephemeris*.)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into ac-

count, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.

Date 1933		Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION *a*	IMMERSION *b*	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION *a*	EMERSION *b*	EMERSION Angle E from N
				h m	m	m	°	h m	m	m	°
Sept.	5	14 Psc	5.9	0 9.3	—0.2	+2.3	19	0 55.8	—0.7	+1.2	281
	5	21 Psc	5.6	10 19.4	—0.9	—3.9	123	10 47.8	0.0	+3.2	177
	6	51 Psc	5.6	7 20.6	—0.9	+1.8	26	8 30.0	—1.7	—0.5	258
	10	q Tau	4.3	3 47.0	—0.3	+1.4	96	4 41.3	+0.1	+2.3	219
	10	16 Tau	5.4	3 54.0	..	..	154	3 56.4	..	..	161
	10	21 Tau	5.8	4 7.4	—0.4	+1.5	90	5 6.1	—0.1	+2.2	224
	10	22 Tau	6.5	4 12.2	—0.6	+1.3	100	5 6.0	+0.1	+2.5	214
	10	18 Tau	5.6	4 17.4	..	..	1	4 43.1	..	..	314
	12	107 B.Aur	6.5	5 58.8	—0.3	+1.7	80	7 7.4	—0.7	+1.6	259
	14	A Gem	5.1	6 33.4	—0.2	+0.8	112	7 33.1	—0.2	+1.8	254
	17	υ Leo	5.0	9 25.3	—0.2	+1.4	92	10 24.4	—0.6	—0.2	315
	30	45 Cap	5.8	4 57.9	—1.0	—0.7	77	5 58.4	—0.2	+0.3	216
Oct.	7	7 Tau	5.9	9 23.0	—1.8	+2.1	33	10 21.2	—1.2	—3.2	302
	11	39 Gem	6.2	3 33.4	+0.8	+2.0	54	4 20.0	—0.4	+0.4	306
	11	40 Gem	6.3	3 45.3	+0.2	+1.2	94	4 44.5	—0.1	+1.4	266
	14	11 Leo	6.5	8 39.6	—0.9	—0.6	140	9 46.3	—1.3	+1.3	269
	15	44 Leo	5.9	8 56.9	—0.5	—1.8	165	9 42.9	—1.0	+2.6	249
	23	48 G.Sgr	6.3	20 35.6	—1.8	+0.6	60	21 49.3	—2.0	—0.7	286
	23	62 B.Sgr	6.0	20 51.7	..	..	151	21 20.8	..	..	194
	23	58 G.Sgr	6.1	23 8.1	—2.4	—2.2	134	23 46.2	+0.2	+1.0	199
	26	31 Cap	6.3	21 20.2	—1.2	+2.0	27	22 23.6	—2.0	+0.5	279
	27	ι Cap	4.3	0 14.1	—0.4	+1.7	11	1 8.4	—2.4	—1.2	281
	29	21 Psc	5.6	23 48.4	—0.5	+2.4	18	0 52.0	—2.0	+0.8	266

OCCULTATIONS VISIBLE IN LONGITUDE +91° 0′, LATITUDE +40° 0′.

Sept.	4	263 B.Aqr	6.1	11 9.1	..	..	342	11 22.2	..	..	314
	5	21 Psc	5.6	10 1.2	—1.9	—2.8	112	10 40.1	0.0	+3.0	180
	6	51 Psc	5.6	7 6.2	..	..	351	7 48.1	..	..	288
	10	q Tau	4.3	3 44.8	+0.4	+1.3	80	4 39.4	+0.2	+1.6	239
	10	21 Tau	5.8	4 4.1	+0.3	+1.5	73	5 0.8	+0.1	+1.6	245
	10	20 Tau	4.1	4 4.4	—0.2	+0.7	117	4 41.2	+0.8	+2.4	200
	10	22 Tau	6.5	4 6.8	+0.2	+1.4	81	5 2.5	+0.2	+1.8	236
	10	16 Tau	5.4	4 37.1	+0.1	+0.7	116	5 14.5	+0.8	+2.2	203
	12	107 B.Aur	6.5	5 56.4	+0.4	+1.8	61	6 53.5	—0.4	+1.0	278
	14	A Gem	5.1	6 33.2	+0.4	+1.0	96	7 29.2	+0.1	+1.2	270
	25	τ Sco	2.8	2 6.1	—1.9	—2.8	147	2 41.6	+0.4	+0.6	212
	30	45 Cap	5.8	4 36.5	—1.2	+0.4	51	5 48.4	—1.0	0.0	236
Oct.	1	167 G.Aqr	6.3	7 17.8	—0.2	+1.3	19	8 10.5	—0.9	—1.4	269
	7	7 Tau	5.9	8 45.2	—1.6	+2.9	33	9 55.8	—2.4	—1.9	288
	12	9 Cnc	6.2	12 15.8	—2.2	—0.4	102	13 42.5	—1.5	—2.2	310
	14	11 Leo	6.5	8 28.9	—0.5	—0.5	142	9 24.1	—0.5	+1.8	258
	14	ψ Leo	5.6	11 46.2	—2.1	+1.8	81	12 47.8	—1.0	—2.8	343
	15	44 Leo	5.9	8 53.5	—0.5	—2.6	174	9 23.5	0.0	+3.7	233
	21	π Sco	3.0	16 47.5	..	..	40	17 7.8	..	..	4
	23	58 G.Sgr	6.1	22 28.9	—2.2	—0.6	115	23 33.6	—1.3	+0.4	225
	29	21 Psc	5.6	23 40.3	..	..	347	0 7.1	..	..	304

OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′.

Sept.	2	31 Cap	6.3	10	20.6	−1.0	−1.2	93	11	10.2	+0.2	+1.0	204
	3	e Aqr	5.4	9	43.1	−1.0	+0.3	53	10	50.7	−0.7	+0.1	233
	5	21 Psc	5.6	9	1.9	−1.9	+0.8	65	10	18.0	−1.1	+1.5	212
	5	25 Psc	6.2	12	20.1	−0.5	+1.8	17	13	12.1	−1.0	−1.6	274
	8	20 H² Ari	6.4	5	59.5	−1.3	+0.3	121	6	27.7	+1.0	+3.5	176
	12	406 B.Tau	5.6	13	46.7	−2.5	+0.7	82	15	22.4	−2.4	−1.2	284
	25	τ Sco	2.8	1	16.0	−2.1	−1.2	129	2	23.6	−1.6	−0.2	242
	30	45 Cap	5.8	4	2.6	−0.4	+2.7	3	4	52.6	−3.3	−0.7	289
	30	μ Cap	5.2	9	39.4	−0.7	−1.2	92	10	28.8	+0.2	+1.0	205
Oct.	2	13 Psc	6.4	9	39.0	−1.4	−0.6	79	10	42.4	−0.5	+1.0	210
	7	18 Tau	5.6	14	41.6	−0.8	−1.3	94	15	50.9	−0.5	−0.8	256
	12	9 Cnc	6.2	11	20.7	−1.6	−0.4	124	12	43.1	−2.0	+1.0	266
	14	ψ Leo	5.6	11	8.4	−0.6	+0.9	101	12	16.6	−1.0	−0.2	305

Notes from Amateurs

A Roof for a Telescope House

A few amateurs may be interested in one simple solution of the roof problem for a small telescope house (Observatory, I like to call it). I claim no originality for the idea, but I have never heard of one just like it before.

The building measures 8.5x8.5 feet, with walls 5.5 feet high. It is framed in 2x4 joists and covered with celotex. The roof is a light skeleton frame, covered with tarpaulin. Along the southern side, the roof is fastened to the upper plate of the wall with three heavy strap hinges. At each end of the roof a 2x4 member has been bolted and carried to the south five feet; each of these is weighted with a counterbalance, made by mixing concrete in some old milk pans. Thy are slightly lighter than the roof itself.

Opening the observatory is a great deal like opening a trunk. The tarpaulin extends down the sides of the roof a few inches and is hooked along the outer edge of the wall. When this is unhooked all around, and the two hooks inside the building at the north disengaged, it is a simple matter to swing the roof with one hand, through 180 degrees, where it rests on two posts. There might be some interest (nowadays) in the fact that the whole affair cost $24.

Inside the building a six-inch pipe has been set in concrete, covered with the usual pipe cap which has been machined on top to take a machined plate. This carries the equatorial head. The telescope itself is a 4-inch refractor.

HARVEY THEW.

4833 Laurel Canyon Road, North Hollywood, California.

Amateur Telescope Makers of Chicago

The convention of Amateur Telescope Makes was held at the Adler Planetarium in the Century of Progress Exposition grounds, Chicago. Thursday, June 22, was open-house day at our headquarters in the Planetarium and visitors were registered from all parts of the country. The meeting was held Friday, June 23. Professor Arthur Howe Carpenter presided and we had the pleasure of listening to Mr. Russell W. Porter, Mr. John Pierce, and Mr. Leo Scanlon. In the evening we met at a supper-luncheon at the Harvard, Yale and Princeton Club, which was followed by general discussion and interesting talks by our visitors.

Saturday afternoon, June 24, we went to Lake Geneva, Wisconsin, and spent an interesting afternoon in Mr. H. H. Porter's private observatory. In the even-

ing we went to Yerkes Observatory. Dr. Struve described the great 40-inch refractor, the other instruments and some of the work of the observatory. Then we made a general tour of inspection. The 40-inch was put in action but the night was too cloudy to permit observations.

The Chicago group enjoyed the convention very much and we hope that our visitors enjoyed it as much as we did. WM. CALLUM, *Secretary.*

1319 West 78th Street, Chicago.

Astrolab Progress Report

Astrolab seems to be holding a continuous summer get-together at the address given below, as amateurs have been dropping in from all parts of the country when they come to the World's Fair.

It has been suggested that a meeting be held in the dark of the moon in September—about the 15th, 16th, and 17th. The place of meeting has not been decided upon. Suggested so far are Chicago, Delaware, Ohio, and Pittsburgh, Pa. We should like to hear from all interested amateurs as to the place you prefer. The foliage will be beautiful and the weather should be ideally cool at that time of the year to take a trip.

Perhaps some of the developments under way now will be announced then. There are rumors that Astrolab will have something new in fork-type mountings —a "meccano" set which will permit of a number of variations so that each amateur can add to or change his equipment in numerous ways and the benefits of each development can be easily passed on from one to another. The polar bowl and declination axis, exclusive of the tube, weigh less than 25 pounds, yet are so rigid that a man weighing 200 pounds can be spun about the polar axis easily. Besides this great rigidity of the polar axis it is easily adjusted to very fine variations to line up with the earth's axis, and any amount of play or friction is readily obtained.

This mounting will be the product of centralized scientific planning wherein a number of amateurs in various parts of the country have worked together on one model which will then be produced with interchangeable parts so that amateurs can readily compare their results and use their experiences as a basis for further experiment and improvement.

A new issue of the Questionnaire has been sent out and is being distributed by Astrolab's members and friends. If you have not received one write in for it and the new issue of the Ronchi Test. Inclose some stamps to share expense. Astrolab invites the correspondence of all interested amateurs. For further information see POPULAR ASTRONOMY since January, 1933, or write to *The Astroscope.*

10728 S. Artesian Ave., Chicago, Ill.

Variable Stars

Monthly Report of the American Association of Variable Star Observers for May and June, 1933

We welcome initial contributions from Miss Louise E. Ballhaussen of Scarsdale, New York, Leo J. Scanlon of Pittsburgh, Pennsylvania, and Royal Perkinson of Fresno, California. We are also pleased to note the return to the ranks of active observers of S. Kanda, Tokyo, Japan; Mr. M. K. Bappu of the Nizamiah

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

April 0 = J.D. 2427163; May 0 = J.D. 2427193; June 0 = J.D. 2427224.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

S SCL
001032
139[10.0 Bl
X AND
001046
135 10.4 Ch
162 9.0 Jo
182 9.2 Jo
185 9.0 Jo
192 9.4 Jo
207 9.2 Jo
209 9.0 Jo
T AND
001726
193 10.5 Ch
223 9.1 Pt
225 8.3 Gy
T CAS
001755
146 9.4 Ch
162 9.4 Jo
168 9.3 Jo
168 9.2 L
177 8.5 We
177 10.0 Ah
178 9.3 L
182 9.4 Jo
185 9.0 Jo
189 8.9 Jo
192 8.6 Jo
193 9.4 Ch
206 8.6 Mc
207 8.5 Mc
207 7.9 L
209 7.9 Jo
214 8.0 Ah
219 7.7 We
220 7.4 L
223 7.2 Pt
224 7.7 Ah
225 7.1 He
234 7.7 Hf
R AND
001838
135 6.8 Ch
149 6.7 Ch
189 7.5 Ma
193 7.2 Ch
223 8.6 Pt
224 8.6 Ah
S TUC
001862
137[13.2 Ht
148[13.2 Ht
152[13.2 Bl
192 9.6 Bl
T PHE
002546
152[13.2 Bl

TY CAS
003162
177 11.9 BR
180 11.9 BR
181 11.9 BR
185 12.0 BR
187 12.0 BR
188 12.1 BR
189 12.1 BR
190 12.2 BR
Y CEP
003179
134 9.7 Ch
149 9.2 Ch
U CAS
004047a
168 10.6 L
178 9.5 L
186 9.4 L
213 8.4 L
223 8.5 L
223 8.7 Pt
RW AND
004132
223 9.6 Pt
V AND
004435
220 12.1 L
X SCL
004435
152[12.6 Bl
RV CAS
004746a
223[13.2 Pt
— CAS
004746b
223 11.0 Pt
W CAS
004958
149 9.1 Ch
162 8.8 Jo
168 8.6 Jo
176 9.0 Jo
177 9.2 Ah
177 9.7 We
182 8.6 Jo
185 8.8 Jo
185 8.9 Ko
189 8.9 Jo
192 8.8 Jo
207 9.2 Jo
209 9.0 Jo
219 9.3 Ra
223 9.2 Pt
U TUC
005475
133 14.0 Sl
151 13.3 Sl
151 12.9 En

U TUC
005475
152 12.8 Bl
153 13.1 Ht
154 12.9 En
158 12.5 Bl
159 12.5 Sl
163 12.4 Ht
165 12.2 Sl
166 12.2 Bl
173 12.0 Bl
176 11.6 Ht
177 11.8 Sl
177 11.8 En
182 11.8 Bl
183 11.3 Ht
183 11.6 Sl
186 11.3 Bl
190 10.6 Ht
192 10.1 Bl
Z CET
010102
118 11.5 L
U SCL
010630
139 10.0 Bl
149 10.8 Bl
166[10.4 Bl
UZ AND
011041
220 13.9 L
S CAS
011272
155 13.0 Ch
224 13.0 Pt
RZ PER
012350
147 12.5 Ch
167 12.5 L
178 12.7 L
221 13.7 L
RU AND
013238
157 13.0 Ch
221 12.5 L
224 12.1 Pt
Y AND
013338
148 10.3 Ch
151 9.8 Ch
179 8.4 L
207 9.4 L
215 9.8 L
224 10.1 Pt
225 10.1 Gy
X CAS
014958
162 12.1 Jo
168 11.9 Jo

X CAS
014958
176 12.3 Jo
176 12.2 Bn
182 12.4 Bn
182 12.0 Jo
185 12.4 Jo
193 12.6 Bn
224 12.5 Pt
U PER
015254
150 11.0 Ch
162 9.8 Jo
166 10.0 Ry
171 10.0 Ry
176 9.8 Ry
176 9.4 Jo
180 9.7 Ry
182 9.4 Jo
185 9.5 Ry
193 9.4 Ry
210 9.3 Ry
212 9.3 Ry
216 9.3 Ry
223 9.3 Ry
224 9.0 Pt
XX PER
015654
147 7.9 Ch
153 8.6 Ch
R ARI
021024
134 9.7 Ch
149 10.5 Ch
W AND
021143a
147[12.9 Ch
224 12.1 Pt
T PER
021258
122 9.0 Hr
130 9.1 Hr
162 8.5 Jo
168 8.3 Jo
176 8.5 Jo
182 8.5 Jo
185 8.6 Jo
185 8.7 Hf
187 9.1 Hr
188 8.7 Ah
189 8.4 Jo
190 8.7 Hf
209 8.7 Jo
224 8.6 Pt
Z CEP
021281
224[12.5 Pt
o CET
021403
134 4.1 Ch
140 4.1 Ch
146 4.1 Ch
149 4.2 Ch
150 3.7 En
151 3.5 En
152 4.3 Ch
154 3.3 En
156 4.9 Ch
158 5.4 Ch
S PER
021558
122 9.2 Hr
130 9.3 Hr
162 8.7 Jo
168 8.6 Jo
169 9.0 Sz
176 8.7 Jo
177 8.9 Pk
182 8.6 Jo
185 8.6 Jo
185 9.7 Hf
187 9.4 Hr
188 9.2 Ah
189 8.7 Jo
R CET
022000
146 10.2 Ch
156 8.8 Ch
RR PER
022150
147 13.2 Ch
174 13.7 L
221[13.7 L
R FOR
022426
139 8.5 Bl
149 8.6 Bl
158 8.5 Bl
166 8.3 Bl
173 8.5 Bl
186 8.5 Bl
192 8.2 Bl
U CET
022813
153 7.5 Ch
RR CEP
022980
153 11.2 Ch
224[13.5 Pt

R TRI
023133
134 8.8 Ch
149 9.3 Ch
162 9.7 Jo
168 9.8 Jo
UY AND
023238
176 10.8 BR
180 10.7 BR
W PER
024356
134 10.4 Ch
150 10.4 Ch
162 9.3 Jo
166 10.1 Ry
168 9.4 Jo
171 10.1 Ry
176 10.0 Ry
176 9.7 Jo
177 10.5 Ch
181 10.0 Ry
182 9.7 Jo
183 9.6 Pt
185 10.1 Ry
185 9.9 Cy
189 9.4 Jo
190 10.0 Ko
192 9.8 Jo
193 10.1 Ry
206 9.8 Mc
209 9.8 Jo
210 10.1 Ry
212 10.0 Ry
216 10.0 Ry
224 9.8 Pt
R HOR
025050
133 12.5 Sl
137 12.6 Ht
139 12.1 Bl
145 12.4 Sl
148 12.3 Ht
148 12.6 En
149 12.1 Bl
151 12.4 En
152 12.3 Sl
153 12.2 Ht
154 12.2 En
158 11.8 Bl
163 12.0 Ht
166 11.4 Bl
168 11.8 Ht
172 11.1 Bl
176 11.2 Sl
176 11.3 Ht
183 11.2 Ht
183 10.9 Sl

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R HOR	U ERI	T CAM	R DOR	R PIC	T LEP
025050	*034625*	043065	*043562*	*044349*	*050022*
186 10.6 Bl	148 12.3 En	209 13.6 L	133 5.1 Sl	153 7.7 Ht	137 8.7 En
192 10.6 Bl	154 12.1 En	210 13.6 Pt	137 5.6 Ht	154 7.4 En	139 8.5 Bl
192 10.9 Ht	177 10.9 En	214 13.3 L	139 5.6 Bl	158 7.7 Bl	148 8.8 En
T HOR	T ERI	221 12.7 L	145 5.1 Sl	163 8.0 Ht	149 8.7 Bl
025751	*035124*	RX TAU	148 5.5 En	166 8.2 Bl	154 8.8 En
133 10.7 Sl	148 10.8 En	043208	148 5.5 Ht	168 7.9 Ht	158 9.2 Bl
137 11.0 Ht	154 10.8 En	147 12.2 Ch	149 5.5 Bl	173 8.1 Bl	162 9.5 Jo
139 10.2 Bl	177 9.2 En	169 11.2 L	151 5.2 Sl	176 7.8 Ht	166 9.0 Bl
145 9.6 Sl	T TAU	177 10.7 L	153 5.6 Ht	177 7.6 En	170 9.8 Bm
148 9.8 Ht	041619	178 10.3 Ch	154 5.3 En	183 7.9 Ht	173 9.8 Bl
148 9.2 En	123 10.1 Hr	R RET	158 5.4 Bl	185 7.5 En	174 9.3 En
149 9.7 Bl	130 10.1 Hr	*043263*	159 5.1 Sl	186 8.4 Bl	177 10.3 En
151 9.5 En	167 10.6 Bm	133 11.9 Sl	163 5.4 En	190 7.9 Ht	185 10.5 En
151 8.7 Sl	170 10.5 Bm	137 12.0 Ht	163 5.6 Ht	192 8.2 Bl	186 10.3 Bl
153 9.6 Ht	177 10.6 Bm	145 11.7 Sl	165 5.3 Sl	V TAU	192 10.4 Bl
154 9.7 En	R TAU	148 11.6 Ht	166 5.5 Bl	044617	S PIC
158 8.6 Bl	042209	148 11.6 En	168 5.5 Ht	149 10.8 Ch	*050848*
163 8.9 Ht	147 9.5 Ch	151 11.2 Sl	173 5.5 Bl	155 10.9 Ch	148 12.9 En
165 8.1 Sl	162 8.5 Jo	152 11.2 Bl	175 5.3 En	162 10.4 Jo	148 12.6 Ht
166 8.3 Bl	167 8.9 Bm	153 11.3 Ht	176 5.4 Sl	168 10.7 Jo	152 12.3 Bl
168 8.3 Ht	168 8.5 Jo	154 11.6 En	176 5.4 Ht	178 12.4 Ch	153 12.4 Ht
173 7.9 Bl	170 8.8 Bm	158 10.7 Bl	177 5.5 En	183 12.7 Pt	154 12.7 En
176 8.1 Ht	173 8.9 Hi	159 10.7 Sl	183 5.4 Ht	TV AUR	158 11.8 Bl
177 7.9 Sl	177 9.2 Bm	163 10.4 Ht	184 5.4 Sl	045048	163 11.7 Ht
183 8.4 Ht	178 8.5 Ch	163 10.5 En	185 5.3 En	177 10.0 BR	166 10.9 Bl
183 7.7 Sl	182 8.8 Hi	165 10.5 Sl	186 5.5 Bl	180 9.9 BR	168 10.8 Ht
186 8.0 Bl	182 8.6 Jo	166 9.8 Bl	190 5.6 Ht	185 9.8 BR	173 9.7 Bl
192 8.5 Ht	183 9.0 Pt	168 10.2 Ht	192 5.4 Sl	187 9.8 BR	175 10.2 En
U ARI	185 8.6 Jo	173 9.5 Bl	192 5.7 Bl	188 9.8 BR	176 9.8 Ht
030514	W TAU	175 9.7 En	R CAE	190 9.7 BR	177 9.6 En
147 14.0 Ch	042215	176 9.7 Ht	*043738*	R ORI	183 9.1 Ht
X CET	147 10.4 Ch	177 9.7 Sl	137 11.1 Ht	045307	185 9.1 En
031401	162 10.2 Jo	177 9.3 En	139 11.0 Bl	147 11.2 Ch	186 8.6 Bl
140 10.7 Ch	168 10.0 Jo	183 8.8 Ht	148 11.5 En	169 11.7 L	188 9.1 En
Y PER	169 10.5 L	184 8.3 Sl	148 11.6 Ht	178 11.8 L	190 8.8 Ht
032043	178 10.5 L	185 8.5 En	149 11.1 Bl	178 11.5 Ch	192 8.6 Bl
150 9.8 Ch	178 9.8 Ch	186 8.2 Bl	153 11.7 Ht	R LEP	R AUR
162 9.0 Jo	182 9.9 Jo	190 7.8 Ht	154 11.7 En	*045514*	050953
168 9.6 Jo	183 10.0 Pt	192 7.5 Bl	158 11.2 Bl	140 8.0 Ch	146 8.0 Ch
176 10.1 Jo	185 10.2 Jo	X CAM	163 11.9 Ht	145 6.7 Sl	153 8.4 Ch
177 11.6 Ch	185 10.2 Cy	043274	166 11.6 Bl	149 7.8 Ch	162 8.4 Jo
180 10.7 Ko	186 10.5 L	149 8.7 Ch	173 11.7 Bl	159 6.4 Sl	168 8.4 Jo
180 10.2 Pk	S TAU	162 9.6 Jo	175 12.5 En	162 6.8 Jo	168 9.2 Ah
182 10.1 Jo	042309	169 11.1 L	176 12.0 Ht	166 6.3 Sl	177 9.3 Ah
183 10.7 Pt	147[13.0 Ch	177 11.7 Ch	177 12.6 En	167 7.5 Ch	180 8.2 Je
185 10.4 Jo	167[13.9 Bm	178 11.4 L	183 12.0 Ht	168 7.0 L	181 9.3 Ra
189 10.5 Jo	173[10.6 Hi	182 11.7 Jo	185 11.9 En	177 6.2 Sl	182 9.2 Jo
192 10.2 Jo	183[12.0 Pt	183 11.5 Pt	186 11.8 Bl	184 5.7 Sl	182 9.2 Ch
197 10.0 Jo	T CAM	185 11.7 Jo	190 12.0 Ht	V ORI	183 9.2 Pt
224 9.8 Pt	043065	185 12.2 Cy	192 12.1 Bl	050003	185 9.3 Jo
R PER	147 13.5 Ch	186 12.0 L	R PIC	147 12.2 Ch	185 9.1 Hf
032335	174 14.0 L	208 12.0 L	*044349*	167 12.9 L	187 9.4 Jo
147 13.5 Ch	186 13.8 L	210 11.9 Pt	137 7.2 En	170 13.0 Bm	188 9.6 Ah
179 13.6 L		214 11.4 L	137 7.5 Ht	177 13.5 Bm	188 9.3 Ra
183 13.5 Pt		221 10.4 L	139 7.1 Bl	178 13.0 Ch	189 9.6 Ah
NOV PER			148 7.3 En	178 13.2 L	189 9.2 Jo
032443			148 7.6 Ht		190 9.0 Je
183 13.1 Pt			149 7.6 Bl		190 9.0 Hf

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R AUR	S AUR	T ORI	RU AUR	S COL	U ORI
050953	052034	*053005a*	053337	*054331*	054920a
192 9.2 Jo	175 9.1 Ch	178 10.5 Ch	162 9.9 Jo	137 12.0 En	146 9.9 Ch
194 9.3 Jo	177 9.2 Ch	179 10.0 L	178 9.8 Ch	139 11.6 Bl	151 10.0 Ch
197 9.3 Jo	177 8.7 Pk	180 11.1 Hr	182 10.4 Jo	148 11.9 En	162 9.3 Jo
204 9.2 Jo	177 10.3 We	181 10.2 B	183 10.2 Pt	148 11.6 Ht	168 10.0 Jo
207 9.3 Jo	178 9.0 Ch	182 10.0 Ch	186 10.0 Bw	149 11.3 Bl	175 10.4 Ch
209 9.4 Jo	180 8.7 Ko	182 10.3 Jo	187 11.2 Jo	153 11.4 Ht	176 10.0 Jo
210 11.0 Pt	182 9.0 Ch	183 10.5 Pt	188 10.7 Jo	154 11.6 En	182 9.9 Jo
211 9.3 We	182 8.8 Jo	184 10.5 Pt	192 10.0 Jo	158 11.2 Bl	182 10.6 Ch
211 10.0 Ra	183 8.6 Pt	184 9.9 Ko	197 10.4 Jo	163 11.1 En	183 10.6 Pt
224 10.3 Ra	184 8.7 Pk	185 9.8 Ko	207 11.8 Jo	163 10.9 Ht	185 9.7 Oy
T PIC	185 8.8 Jo	185 10.6 Jo	209 12.1 Jo	166 10.4 Bl	186 10.3 Gy
051247	185 9.3 Gy	185 10.3 Cy	210 10.8 Pt	168 10.8 Ht	188 10.5 Ra
148 12.5 En	185 9.2 Hf	186 10.0 Ko	U AUR	173 9.6 Bl	189 10.5 Jo
152 13.5 Bl	187 9.0 Jo	187 11.1 Hr	053531	175 10.0 En	192 10.5 Jo
153 13.4 Ht	189 9.1 Ch	187 10.5 Pt	150 13.2 Ch	176 9.6 Ht	197 10.4 Jo
154 12.5 En	189 8.8 Jo	187 10.1 L	169 13.0 L	177 9.9 En	V CAM
163 13.2 Ht	190 9.3 Hf	S CAM	178 13.0 L	183 9.5 Ht	054974
168 12.0 Ht	192 8.7 Jo	053068	178 13.0 Ch	185 9.6 En	168 10.4 L
176 11.5 Ht	193 8.7 Pk	149 9.6 Ch	180 12.6 B	186 8.6 Bl	178 10.5 L
177 11.5 En	197 8.8 Jo	162 8.6 Jo	183 12.6 Pt	190 9.1 Ht	180 10.9 Ch
183 11.4 Ht	210 8.6 Pt	168 8.5 Jo	186 12.7 L	192 9.0 Bl	181 10.7 B
186 11.1 Bl	W AUR	182 8.6 Jo	208 10.1 L	Z TAU	183 10.8 Pt
188 10.3 En	052036	183 9.1 Pt	210 9.8 Pt	054615a	186 10.8 L
190 10.9 Ht	147[13.2 Ch	185 8.7 Jo	214 9.4 L	150 11.4 Ch	208 11.2 L
192 11.0 Bl	174 14.2 L	187 8.8 Jo	SU TAU	169 12.0 L	210 11.3 Pt
T COL	178 13.6 Ch	187 8.8 Ch	054319	170 11.6 Bm	214 11.2 L
051533	186 13.9 L	189 8.8 Jo	146 9.7 Ch	178 12.0 Bm	Z AUR
139 12.0 Bl	209 12.5 L	192 8.7 Jo	150 9.7 Ch	178 12.1 Ch	055353
148 12.1 Ht	214 12.4 L	197 8.6 Jo	154 9.8 Br	178 12.3 L	162 9.9 Jo
149 12.3 Bl	S ORI	210 8.6 Pt	155 9.7 Ch	186 12.6 L	168 10.2 Jo
153 12.4 Ht	*052404*	RR TAU	167 9.6 L	RU TAU	181 10.9 B
154 11.9 En	147 11.5 Ch	053326	168 9.5 L	054615c	182 10.6 Jo
158 12.0 Bl	167 12.0 Ch	154 11.3 Br	169 9.5 L	150 11.6 Ch	183 10.5 Jo
163 12.1 En	168 11.6 Rb	167 10.8 L	170 9.6 L	169 11.4 L	183 10.3 Pt
163 12.3 Ht	176 11.7 Rb	168 10.8 L	171 9.5 L	170 11.3 Bm	185 11.1 Cy
166 12.1 Bl	178 12.0 Ch	169 11.5 L	173 9.5 L	178 11.3 Bm	185 10.8 Jo
168 11.7 Ht	183 12.0 Pt	170 12.5 L	174 9.6 L	178 11.7 Ch	187 10.8 Jo
173 11.4 Bl	T ORI	170 12.2 Bm	175 9.7 Ch	178 11.7 L	187 10.1 Pt
175 11.9 En	*053005a*	171 11.8 L	178 9.7 Ch	186 11.7 L	189 10.1 Pt
176 11.6 Ht	122 10.4 Hr	173 11.8 L	178 9.5 L	R COL	189 11.4 B
177 11.4 En	130 10.3 Hr	174 11.7 L	179 9.6 L	*054629*	189 10.9 Jo
183 10.9 Ht	140 11.2 Hr	177 12.2 Bm	180 9.5 Jo	137[12.5 En	197 11.0 Jo
185 10.8 En	147 10.2 Ch	178 11.7 L	181 9.6 Pt	148[13.0 Ht	205 10.3 Pt
186 10.5 Bl	150 10.8 Ch	179 12.0 L	182 9.5 B	152[13.0 Bl	207 10.9 Jo
190 10.7 Ht	151 10.8 Ch	181 12.3 B	183 9.6 Pt	154[13.0 En	207 9.9 Mc
192 10.2 Bl	155 10.4 Ch	181 11.8 Pt	184 9.6 Pt	163[13.0 Ht	209 10.3 Pt
S AUR	162 11.0 Ch	182 12.2 Br	184 9.6 Jo	177[13.0 En	215 10.7 Pt
052034	162 10.6 Jo	183 11.8 Pt	185 9.6 Jo	183[13.0 Ht	225 10.6 Pt
095 9.9 So	167 10.2 L	184 12.3 Pt	185 9.8 Cy	186[13.0 Bl	RS AUR
122 9.6 So	168 10.1 L	185 12.3 Cy	186 9.4 L	190[13.0 Ht	055646a
147 8.8 Ch	168 10.3 Jo	186 12.4 Ko	186 9.5 Jo	192[13.0 Bl	171 9.8 BR
151 8.8 Ch	169 10.1 L	186 12.7 L	186 9.5 Gy	σ ORI	176 10.0 BR
155 8.8 Ch	170 10.1 L	187 13.0 L	187 9.4 L	054907	180 10.0 BR
160 9.8 So	170 10.1 Ch	187 12.5 Pt	187 9.5 Pt	133 0.1 Sl	185 10.1 BR
162 8.6 Jo	171 10.2 L	190 12.5 Pt	187 9.7 Ch	177 0.1 Sl	187 10.2 BR
162 9.0 Ch	173 10.2 L	208 12.1 L	190 9.7 Pt	186 0.1 Sl	190 10.2 BR
167 8.9 Ch	174 10.3 L				
168 8.7 Jo	178 10.0 L				

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R Oct			AG Aur			X Gem			Z CMa			R CMi			V Gem		
055686			062047			064030			*065911*			070310			071713		
133	11.2	Sl	187	11.0	L	176	8.6	Bn	180	9.8	Sl	168	7.8	Jo	178	11.9	L
139	11.6	Bl	207	10.9	L	176	8.7	Tw	183	9.8	Sl	169	7.3	L	178	12.1	Ch
148	11.9	Ht	214	10.7	L	180	9.3	B	V CMi			176	8.1	Hf	182	11.5	B
149	11.5	Bl	U Lyn			180	9.0	Cy	070109			177	6.8	Ch	183	12.1	Jo
153	11.8	Ht	063159			182	9.2	Bn	150[	13.5	Ch	178	7.2	L	183	11.8	Pt
158	11.6	Bl	181	14.0	B	183	9.4	Hf	174[	14.2	L	181	7.8	Oy	185	11.5	Jo
159	11.2	Sl	R Mon			185	9.1	Gy	183[	13.5	Pt	182	7.6	Jo	186	11.7	Jo
166	11.8	Bl	063308			190	9.3	We	187[	14.2	L	183	8.1	Hf	186	11.6	Bw
177	11.8	Sl	150	13.0	Ch	193	9.6	Bn	209[	12.7	Pt	183	7.2	Pt	187	11.4	L
186	12.0	Bl	155	13.0	Ch	198	10.5	Bn	R Gem			185	7.8	Oy	200	10.8	Bw
187	12.2	Sl	178	12.8	Ch	207	11.4	Bn	070122a			185	7.2	Gy	208	10.6	L
192	12.1	Bl	182	12.0	B	Y Mon			146	7.7	Ch	185	7.7	Jo	209	11.0	Pt
X Aur			187	12.8	Ch	065111			155	7.8	Ch	187	7.5	Jo	215	10.6	L
060450			AA Aur			150	13.8	Ch	162	7.6	Jo	187	7.2	L	S CMi		
148	11.7	Ch	063444			174	14.4	L	168	7.9	Jo	188	8.0	Hf	072708		
152	11.5	Ch	180	11.8	BR	178	13.8	Ch	168	8.4	Ah	189	7.4	Jo	135	11.0	Ch
169	10.5	L	185	11.5	BR	181	14.1	B	175	9.1	He	192	8.1	Hf	152	10.4	Ch
175	10.4	Ch	187	11.4	BR	187	14.3	L	176	8.6	BR	194	8.0	Hf	162	9.7	Ch
178	10.2	Ch	190	11.2	BR	X Mon			177	8.8	Ch	194	8.2	Sh	162	9.1	Jo
178	10.1	L	Nov Pic			*065208*			177	8.7	We	197	7.5	Jo	168	8.8	Jo
180	10.3	B	*063462*			162	7.9	Jo	177	9.5	Ah	204	7.6	Jo	172	9.2	Ch
181	10.3	Sf	137	8.7	En	168	7.8	Jo	178	9.0	He	207	7.8	Jo	176	9.7	Tw
183	9.7	Jo	137	8.4	Ht	169	7.1	L	178	9.1	Ra	209	7.4	Pt	180	9.1	Ko
183	10.1	Pt	148	8.5	Ht	176	7.7	BR	180	8.8	BR	209	8.2	L	182	8.6	Jo
185	9.5	Jo	148	8.8	En	178	7.2	L	182	9.3	B	209	8.3	Oy	182	9.0	Ch
185	10.1	Hf	153	8.4	Ht	180	7.5	BR	182	8.8	Jo	210	8.5	Hf	183	9.0	Hf
185	10.2	Sf	154	8.7	En	180	7.2	Sq	183	9.5	Hf	214	8.5	Hf	183	9.0	Pt
186	9.8	L	163	8.7	En	182	7.3	Pk	183	8.9	Pt	215	8.1	L	185	8.7	Jo
187	9.5	Ch	163	8.4	Ht	182	7.6	Jo	185	8.9	Jo	R Vol			186	9.0	Ko
189	9.3	Ch	168	8.4	Ht	185	7.6	Jo	188	9.6	Hf	*070772*			187	8.6	Jo
189	9.5	Jo	174	8.5	En	186	7.2	Gy	188	9.7	Ah	137[	13.4	Ht	188	9.0	Hf
192	9.9	Sf	177	8.5	En	187	7.7	Jo	189	9.8	Ah	151[	12.6	En	189	8.5	Jo
203	9.5	Sf	177	8.4	Ht	187	7.1	L	189	9.3	BR	153[	13.4	Ht	191	8.7	Ch
208	8.6	L	183	8.5	Ht	189	7.2	Jo	189	9.1	Ch	163	12.6	En	192	8.8	Hf
210	9.1	Sf	190	8.5	Ht	192	7.0	Jo	189	9.1	Jo	177	13.6	En	192	8.4	Jo
210	8.8	Pt	S Lyn			197	7.1	Jo	191	9.7	Ch	183[	13.4	Ht	194	8.5	Sh
V Aur			063558			R Lyn			192	9.7	Hf	190[	13.4	Ht	194	8.7	Hf
061647			155	9.6	Ch	065355			194	9.7	Sh	L_2 Pup			197	8.4	Jo
150	10.6	Ch	162	9.7	Jo	155	12.8	Ch	197	9.8	Sh	*071044*			203	8.5	Hf
169	9.3	L	164	9.9	Ry	174	12.9	L	197	9.3	Jo	133	5.8	Sl	204	8.3	Jo
178	9.0	Ch	169	10.4	L	187	13.4	L	204	9.4	Jo	159	5.3	Sl	207	8.3	Jo
178	8.7	L	171	10.2	Ry	187	13.2	Ch	207	9.6	Jo	166	4.8	Sl	209	8.1	Jo
182	9.2	B	176	10.6	Ry	214[	13.8	L	209	9.7	Jo	177	4.5	Sl	209	8.4	Pt
185	9.6	Gy	178	10.9	L	RS Gem			209	11.3	Pt	180	4.3	Sl	210	8.3	Hf
187	8.6	L	180	10.4	B	065530			211	9.5	Ra	183	4.3	Sl	211	8.5	Hf
208	8.8	L	180	10.7	Ry	162	10.4	Jo	Z Gem			187	4.2	Sl	211	8.7	Sh
214	8.7	L	187	11.0	L	183	11.0	Jo	070122b			192	4.0	Sl	214	8.3	Hf
V Mon			187	10.9	Ch	183	11.3	Pt	183	12.4	Pt	RR Mon			T CMi		
061702			189	10.8	Ry	185	10.8	Jo	209	12.6	Pt	071201			072811		
150	11.2	Ch	190	11.4	Bw	209	11.0	Jo	TW Gem			150[	13.2	Ch	150	11.0	Ch
180	9.2	Ch	193	11.1	Ry	209	11.7	Pt	070122c			174[	13.4	Hi	162	11.5	Jo
183	8.5	Pt	208	11.5	L	213	11.5	So	178	8.4	He	178	13.6	L	162	10.9	Ch
184	9.1	Ko	208	11.5	Ry	Z CMa			183	8.2	Pt	187	13.2	L	168	11.4	Jo
191	8.8	Ch	210	12.5	Pt	*065911*			209	8.3	Pt	208[	10.9	Hi	169	10.8	L
AG Aur			214	11.5	L	133	9.0	Sl	R CMi			V Gem			178	11.4	L
062047			214	11.8	Ry	159	10.2	Sl	070310			071713			178	10.7	Ch
169	10.0	L	216	12.1	Ry	166	9.7	Sl	150	8.0	Ch	162	13.4	Ch	182	11.5	Jo
178	10.7	L	223	12.5	Ry	177	9.4	Sl	162	8.3	Jo	167	13.1	L	183	10.4	Pt

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T CMi	S Gem	T Gem	R Cnc	RT Hya	T Hya
072811	073723	074323	081112	*082405*	*085008*
185 11.0 Jo	168 9.3 Jo	189 8.3 Jo	197 6.8 Jo	170 8.2 L	179 9.5 L
187 11.2 L	177 9.3 We	189 8.9 Ah	203 6.7 Hf	177 8.6 Th	180 9.5 B
189 11.5 Jo	177 9.2 Ch	191 8.2 Cy	204 6.7 Jo	179 8.0 L	180 9.5 Cy
192 11.7 Jo	180 9.1 Cy	192 8.7 B	205 6.7 B	182 8.5 Jo	182 9.4 Ch
197 11.9 Jo	182 9.2 Jo	192 8.3 Jo	208 6.7 Hi	183 8.3 Pt	183 9.2 Pt
208 11.2 L	183 9.2 Jo	204 8.4 Jo	209 7.5 Pt	184 8.3 Ko	183 9.2 Bc
209 11.6 Pt	183 9.5 Pt	205 8.5 B	209 6.9 Jo	185 8.6 Jo	185 9.4 Jo
Z Pup	185 8.8 Jo	207 8.4 Jo	209 7.1 Oy	186 8.3 Ko	185 9.1 B
072820b	187 9.1 Ch	209 8.6 Jo	210 6.6 Cy	207 8.0 L	187 9.4 Jo
151[12.1 En	189 8.5 Jo	209 9.0 Pt	210 7.0 Sf	209 7.9 Pt	189 9.2 B
170[13.3 Bm	191 9.1 Cy	210 8.5 Cy	210 7.3 Sq	209 8.9 Fn	189 9.0 Jo
S Vol	192 8.7 Jo	U Pup	210 6.5 Hf	215 7.6 L	192 8.7 Jo
073173	192 9.6 B	*075612*	211 6.6 Sh	R Cha	197 8.5 Jo
137 13.0 Ht	204 9.5 Jo	152 10.3 Ch	211 6.6 Hf	*082476*	215 7.5 L
152 13.0 Bl	205 9.8 B	167 11.7 L	211 7.4 Ad	134[12.6 Sl	207 7.9 L
153 12.5 Ht	207 9.9 Jo	179 12.1 L	214 7.0 Hf	152[12.6 Bl	209 7.8 Pt
154 12.8 En	209 10.4 Jo	180 12.0 B	215 7.0 Hf	154[12.4 En	T Cnc
158 12.8 Bl	209 9.6 Pt	182 11.8 Ch	215 6.8 We	163[12.6 Ht	085120
163 12.6 En	210 9.9 Cy	186 11.8 Bw	221 7.1 Sq	177[12.6 Sl	152 8.0 Ch
165 11.8 Ht	211 9.0 We	187 12.3 L	223 7.1 Oy	183[12.6 Ht	162 7.8 Jo
177 11.6 Ht	W Pup	R Cnc	V Cnc	187[12.6 Bl	168 8.0 Jo
178 12.2 En	*074241*	081112	081617	U Cnc	180 8.5 Cy
183 11.4 Ht	137 8.9 Ht	135 9.3 Ch	135 8.0 Ch	083019	182 8.2 Jo
185 11.8 En	139 8.7 Bl	162 8.5 Jo	169 7.6 L	174 13.4 L	182 8.0 Ch
186 11.6 Bl	147 8.9 En	168 8.2 Jo	175 7.7 Th	183 12.4 Ch	183 8.0 Pt
190 11.4 Ht	149 9.1 Bl	177 8.7 Ah	176 8.3 Tw	185 11.9 Sf	185 7.7 Jo
192 11.1 Bl	151 9.4 En	177 8.5 Ch	176 7.6 We	185 12.0 Cy	187 8.0 Jo
U CMi	153 9.2 Ht	178 7.5 Ra	177 8.0 Ah	185 12.3 Bw	189 7.7 Jo
073508	154 9.6 En	180 8.3 Cy	177 7.8 Th	192 11.5 B	191 8.8 Cy
150 9.0 Ch	158 9.5 Bl	180 8.3 Sq	179 7.7 L	192 11.5 Sf	192 8.0 Jo
162 9.3 Ch	163 9.8 En	181 7.4 Se	180 7.9 Cy	203 11.2 Sf	204 7.9 Jo
162 8.8 Jo	163 10.4 Ht	181 8.5 Oy	181 8.4 Th	207 10.4 L	209 8.0 Jo
168 8.9 Jo	166 9.9 Bl	182 8.0 Jo	182 7.7 Ch	210 10.8 Sf	209 8.2 Pt
169 9.5 L	168 10.4 Ht	183 7.4 Se	183 8.2 Th	211 10.7 Cy	210 9.4 Cy
178 9.9 L	173 11.0 Bl	183 8.4 Hf	183 7.6 Pt	212 10.8 B	212 8.9 B
178 9.6 Ch	175 11.0 En	183 8.5 Pt	185 8.3 Gy	212 11.0 Bh	S Pyx
180 10.5 Cy	177 11.2 Ht	185 7.7 Jo	185 7.8 Jo	212 10.9 Mg	*090024*
182 10.1 B	178 11.4 En	185 8.3 Oy	185 8.4 Hf	214 10.6 L	036 10.6 Ko
182 9.4 Jo	183 11.4 Ht	185 8.3 Sf	186 8.3 Sf	X UMa	050 9.2 Ko
183 10.3 Pt	185 11.6 En	186 7.5 Se	188 8.5 Hf	083350	670 8.4 Ko
185 9.7 Jo	187 11.5 Bl	187 7.5 Jo	188 8.6 Ah	183[12.9 Pt	170 11.7 Bm
187 10.0 Jo	190 11.7 Ht	188 8.0 Ah	189 8.7 Ah	209 11.7 Pt	T Pyx
187 10.4 L	193 11.6 Bl	188 7.5 Sq	189 8.3 Th	212 10.7 Bh	*090031*
189 9.6 Jo	T Gem	188 8.3 Hf	191 8.8 Ah	212 10.9 Mg	152 ∫t Bl
192 9.9 Jo	074323	189 8.1 Ah	191 8.1 Cy	S Hya	187 ∫t Bl
197 10.2 Jo	149 9.7 Ch	189 7.9 Cy	192 8.1 B	084803	V UMa
204 10.8 Jo	152 9.2 Ch	189 7.5 Se	192 8.4 Hf	151 12.0 Ch	090151
207 11.0 Jo	162 8.9 Ch	189 7.5 Ra	203 8.6 Hf	182 13.0 Ch	162 10.5 Jo
208 11.1 L	162 9.0 Jo	189 7.4 Jo	205 8.6 B	183 12.5 Pt	168 10.6 Jo
209 11.2 Pt	168 8.8 Jo	190 7.7 Je	207 8.6 L	185 12.7 Jo	168 10.6 L
209 11.2 Jo	177 8.8 Ch	191 7.5 Cy	209 8.3 Pt	185 13.4 B	179 10.8 L
215 10.9 L	180 9.0 Cy	191 7.6 Ch	210 8.7 Hf	209 13.1 Pt	182 10.5 Jo
S Gem	182 8.7 Jo	192 7.3 Jo	211 8.5 Cy	212 12.9 B	185 10.7 Jo
073723	183 8.9 Jo	192 7.5 Sf	214 8.9 Sf	T Hya	187 10.7 Jo
149 10.8 Ch	183 8.8 Pt	192 7.0 B	214 8.5 L	*085008*	189 10.3 Jo
152 10.5 Ch	185 8.6 Gy	192 7.7 Hf	220 9.2 Pk	151 10.4 Ch	192 10.4 Jo
162 9.6 Ch	185 8.5 Jo	194 7.1 Hf		170 9.7 L	192 10.2 B
162 9.5 Jo	187 8.4 Ch	194 6.9 Sh		177 9.5 Bc	207 10.5 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V UMA	R CAR	R LMI	R LEO	Z VEL	S CAR
090151	*092962*	093934	094211	*094953*	*100661*
207 10.0 Mc	137 6.4 Ht	185 11.0 Jo	191 8.9 Ah	159 8.2 Sl	153 5.3 Sl
207 10.3 L	140 6.4 Bl	189 11.0 Sz	191 9.1 Hf	159 8.9 Bl	159 5.5 Bl
209 10.6 Jo	149 5.5 Bl	190 11.2 Ch	191 9.0 Ch	163 8.9 Ht	163 5.5 Ht
213 10.0 So	150 5.1 En	190 11.0 Je	192 9.1 Hf	166 8.5 Sl	166 5.5 Sl
214 10.1 L	152 5.5 Sl	191 10.5 Hf	192 8.8 Jo	168 8.9 Ht	168 5.8 Ht
223 10.3 L	153 5.6 Ht	194 10.3 Hf	193 9.3 Sq	173 9.5 Bl	173 5.5 Bl
225 10.6 So	154 5.0 En	194 10.1 Sh	194 9.2 Sh	176 9.3 Ht	174 6.0 En
225 10.4 B	158 4.3 Bl	201 10.5 Je	194 9.3 Hf	178 9.5 En	176 6.0 Ht
W CNC	159 5.1 Sl	207 10.5 Hi	194 8.8 Jo	180 9.6 Sl	177 5.7 Sl
090425	163 5.0 Ht	209 10.5 Je	201 9.0 Je	183 10.0 Ht	178 6.3 En
178 13.4 L	166 4.7 Sl	209 10.4 Pt	203 9.6 Hf	184 10.1 Sl	183 6.0 Ht
182 13.2 Ch	168 4.9 Ht	211 10.3 Sh	204 9.8 Ra	187 10.3 Bl	183 6.1 Sl
183 13.2 Pt	173 5.0 Bl	211 10.3 Hf	204 9.2 Sq	187 10.3 En	187 6.2 Sl
207 12.3 L	174 4.5 En	214 10.2 Je	206 9.6 Mc	190 10.6 Ht	187 6.0 Bl
209 12.4 Pt	176 4.5 Ht	215 10.1 Hf	207 9.6 Mc	192 10.4 Bl	187 6.5 En
214 12.1 L	177 4.6 Sl	220 10.0 Je	209 8.8 Pt	V LEO	190 6.2 Ht
216 12.0 Be	178 4.4 En	222 9.4 Je	209 9.0 Jo	095421	192 6.4 Bl
RW CAR	180 4.6 Sl	221 9.1 Sz	209 9.5 Je	134 9.5 Ch	U UMA
091868	182 4.4 En	225 8.8 B	209 9.7 An	146 10.0 Ch	100860
137 9.7 En	183 4.6 Sl	232 8.0 Sh	209 9.8 Oy	180 10.9 Cy	148 6.6 Ch
137 9.9 Ht	183 4.9 Ht	232 8.0 Hf	210 9.8 Hf	183 11.9 Pt	155 6.7 Ch
140 9.9 Bl	187 4.7 Sl	233 8.9 Gy	211 9.7 Hf	189 12.0 Cy	190 6.9 Ch
149 10.6 Bl	187 4.7 En	234 8.1 Hf	211 9.6 Sh	190 11.9 Ch	Z CAR
150 11.1 En	187 5.1 Bl	237 7.9 Sh	211 8.9 Sq	209 12.7 Pt	*101058a*
155 10.4 Ht	190 4.9 Ht	RR HYA	211 9.7 We	210 12.7 Cy	137 11.1 En
154 11.4 En	192 4.7 Sl	*094023*	212 9.3 Ah	212 12.7 B	137 11.6 Ht
158 11.1 Bl	192 5.4 Bl	150 10.6 En	213 9.7 Mc	213 12.6 So	140 10.9 Bl
163 11.4 Ht	X HYA	154 10.2 En	214 9.3 Je	232 12.6 So	149 11.4 Bl
166 11.7 Bl	*093014*	170 9.3 Bm	214 9.5 Ah	RR CAR	150 11.4 En
173 11.8 Bl	148 12.8 Ch	178 9.3 En	218 9.6 Sh	*095458*	153 11.7 Ht
177 11.9 Ht	178 12.6 Bm	178 8.8 Bm	221 9.0 Sz	137 8.4 Ht	159 11.5 Bl
178 11.9 En	182 12.8 Ch	187 9.5 En	222 9.5 Sq	151 8.3 En	163 12.0 Ht
183 12.5 Ht	183 12.5 Pt	R LEO	226 9.5 B	153 8.4 Ht	168 12.1 Ht
187 12.4 En	185 12.4 Cy	094211	230 9.2 Wa	163 8.3 Ht	173 11.8 Bl
187 12.1 Bl	185 12.6 B	134 7.4 Ch	1 CAR	168 8.2 Ht	176 12.1 Ht
190 12.3 Ht	209 12.5 Pt	149 8.3 Ch	*094262*	176 8.0 Ht	178 12.1 En
Y VEL	212 11.9 B	162 7.7 Jo	134 3.6 Sl	183 8.0 Ht	183 12.2 Ht
092551	212 11.6 Bh	165 8.7 Ch	159 3.5 Sl	187 8.0 En	187 12.0 Bl
137 11.6 Ht	212 11.8 Mg	167 8.6 Pa	166 3.5 Sl	190 8.0 Ht	187 12.1 En
140 12.0 Bl	Y DRA	168 8.0 Jo	177 4.0 Sl	RV CAR	190 12.3 Ht
148 12.1 Ht	093178	176 9.2 We	184 4.0 Sl	*095563*	192 12.3 Bl
149 12.1 Bl	148 13.4 Ch	176 8.8 Hf	187 3.9 Sl	137 13.1 Ht	W VEL
150 12.4 En	155 13.3 Ch	177 8.8 Ah	192 3.8 Sl	153 13.1 Bl	*101153*
152 12.2 Bl	178 13.7 L	178 8.0 Ra	Y HYA	163 13.1 Ht	150 12.0 En
153 12.1 Ht	185 12.6 Cy	182 8.4 Jo	*094622*	177 13.2 Ht	153 12.6 Bl
154 12.4 En	187 12.1 Ch	183 8.9 Pa	151 8.0 En	183 12.8 Ht	159 12.5 Bl
158 12.1 Bl	189 11.9 Ch	183 8.9 Hf	178 7.5 En	187 12.0 Bl	176 12.5 Ht
163 12.0 Ht	207 9.5 L	183 8.5 Pt	183 6.6 Pt	187 12.1 En	178 12.0 En
173 12.3 Bl	210 9.7 Cy	185 8.9 Oy	209 6.3 Pt	190 12.0 Ht	183 12.0 Ht
176 12.4 Ht	214 9.5 L	186 8.5 Jo	Z VEL	192 11.9 Bl	187 12.0 En
178 12.6 En	223 9.3 L	187 8.9 Hf	*094953*	S CAR	187 12.0 Bl
183 12.4 Ht	R LMI	188 8.8 Ah	134 8.9 Sl	*100661*	190 12.3 Ht
187 12.4 Bl	093934	189 8.8 Ah	137 8.8 Ht	134 5.6 Sl	192 11.7 Bl
192 12.5 Bl	151 11.8 Ch	189 8.9 Sz	137 8.9 En	137 5.5 Ht	U HYA
R CAR	183 11.3 Pt	189 8.7 Jo	140 9.0 Bl	140 5.5 Bl	*103212*
092962	183 11.7 Gy	190 9.0 Je	149 8.9 Bl	149 5.5 Bl	075 5.9 Km
134 6.6 Sl	185 10.5 Hf	190 9.0 Hf	150 8.9 En	150 5.5 En	096 5.7 Km
137 6.3 En	185 9.0 We		153 8.7 Ht	153 5.0 Ht	106 5.9 Km

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.	Est.	Obs.
U HYA		
103212		
124	5.6	Km
129	6.0	Kd
134	5.9	Km
146	5.3	Ch
155	5.5	Ch
156	5.7	Ka
158	5.7	Ka
160	5.6	Ka
161	5.8	Ka
175	5.5	Ka
176	5.6	Ka
177	5.7	Ka
178	5.7	Ka
179	5.7	Ka
183	5.7	Ka
185	5.7	Ka
186	5.6	Ka
190	5.6	Ka
190	5.7	Ch
191	5.7	Ka
204	5.6	Ka
206	5.2	Mc
207	5.0	Mc
207	5.5	Ka
209	5.6	Ka
211	5.6	Ka
213	5.1	Mc
RZ CAR		
103270		
137[	13.1	Ht
151[	13.1	En
163[	13.6	Ht
178[	13.1	En
183[	13.6	Ht
190[	13.6	Ht
R UMA		
103769		
140	7.5	Ch
162	7.2	Jo
165	7.2	Ch
168	7.4	Jo
176	7.8	Cy
176	7.8	We
177	7.6	Ah
177	7.7	Ba
177	7.6	Ch
180	7.7	Je
181	8.0	Hf
182	7.8	Jo
182	8.4	Br
183	8.2	Bc
183	8.2	Bf
183	7.8	Gy
183	8.2	Hf
183	7.6	Pt
185	8.0	Cy
185	8.0	Jo
185	8.2	So
R UMA		
103769		
185	8.0	Gy
187	8.3	Hf
187	8.2	Jo
188	8.2	Ah
189	8.2	Ah
189	8.0	Bc
189	7.9	Sz
190	8.5	We
191	8.3	Ah
191	8.3	Hf
191	8.2	Ch
192	8.2	Jo
194	8.6	Hf
194	8.6	Sh
197	8.4	Jo
203	9.0	Hf
204	9.0	Ah
207	9.2	Mc
207	8.8	Hi
209	8.7	Jo
209	8.2	Je
209	9.2	Pt
210	8.9	Gy
210	9.1	Hf
210	8.8	Cy
211	9.0	We
211	9.1	Hf
211	8.6	Ad
212	9.1	Ah
213	9.1	So
213	9.4	Mc
214	8.4	Je
214	9.3	Ah
216	9.0	Gs
217	9.4	Ah
218	9.4	Gy
220	8.8	Je
221	9.2	Sz
222	9.0	Je
224	9.5	B
224	9.4	Hi
225	9.5	So
225	9.4	Gy
234	9.9	Gy
234	10.0	Hf
237	9.9	Sh
V HYA		
104620		
140	6.5	Bl
146	7.7	Ch
149	7.1	Bl
151	7.5	En
153	8.0	Ch
159	7.2	Bl
162	6.7	Jo
165	7.8	Ch
167	7.2	Bl
168	7.2	Jo
V HYA		
104620		
170	6.5	L
173	7.1	Bl
175	7.7	Ch
176	7.4	Jo
179	6.7	L
182	7.2	Jo
183	7.3	Jo
183	6.3	Pt
184	6.7	Ko
187	7.3	Jo
187	6.8	Bl
189	7.0	Jo
190	7.0	Ch
192	6.9	Bl
192	7.2	Jo
194	6.8	Jo
203	6.9	Se
204	7.0	Jo
207	6.5	L
207	6.8	Se
209	6.6	Pt
209	7.3	Jo
210	6.8	Se
211	6.8	Se
214	6.8	Se
214	6.5	L
221	6.7	Ko
RS HYA		
104628		
153	13.4	Bl
187	13.9	Bl
W LEO		
104814		
148	13.8	Ch
178	14.2	L
178	14.1	Bm
207	14.0	L
212	14.5	Bh
212	13.8	Mg
214	14.1	L
216	14.0	Be
RS CAR		
110361		
151[	12.3	En
178[	12.3	En
S LEO		
110506		
148[	13.1	Ch
178[	14.1	L
182[	13.5	Br
207	12.5	L
209	12.5	Pt
210	12.2	Cy
212	12.1	Bh
212	12.0	Mg
214	12.1	L
216	11.7	Be
223	11.5	L
RY CAR		
111561		
137	13.1	Ht
153[	13.5	Bl
163[	13.1	Ht
177[	13.1	Ht
183[	13.1	En
187[	13.5	Bl
190[	13.1	Ht
RS CEN		
111661		
137	11.6	En
137	11.7	Ht
140	10.7	Bl
149	9.9	Bl
150	9.8	En
153	9.4	Ht
159	9.2	Bl
163	9.2	Ht
167	9.1	Bl
168	9.3	Ht
173	9.1	Bl
174	9.1	En
177	9.1	Ht
178	8.9	En
183	9.0	En
183	9.0	Ht
187	9.2	En
187	9.0	Bl
190	9.0	Ht
192	9.0	Bl
X CEN		
114441		
137	10.9	Ht
140	9.7	Bl
150	8.8	Bl
151	8.4	En
153	8.6	Ht
159	8.3	Bl
163	8.5	Ht
167	8.3	Bl
168	8.2	Ht
173	8.0	Bl
176	8.3	Ht
178	8.4	En
183	8.4	Ht
187	8.2	En
187	8.4	Bl
190	8.4	Ht
192	8.6	Bl
AD CEN		
114858		
137	9.3	Ht
153	9.3	Ht
163	9.5	Ht
168	9.4	Ht
177	9.5	Ht
183	9.5	Ht
190	9.3	Ht
W CEN		
115058		
137[	12.6	Ht
153	13.5	Bl
163[	12.6	Ht
177	12.9	Ht
183[	12.6	En
187	12.7	Bl
187	13.0	En
190	12.7	Ht
192	12.8	Bl
R COM		
115919		
148	9.5	Ch
180	8.9	Ch
180	9.1	Cy
182	9.5	Br
185	9.4	So
185	8.5	We
187	8.9	Hf
188	9.2	Lg
189	9.5	Cy
192	9.2	Hf
210	9.6	Cy
213	10.4	Bh
213	10.3	Mg
213	9.0	We
213	10.3	So
SU VIR		
120012		
148	12.2	Ch
169	12.9	L
179	13.2	L
180	13.3	Ch
182	13.3	Br
183	13.3	Bw
184[	12.8	Pt
185	13.9	B
207	14.6	L
207	14.0	Bw
215	14.5	L
234	13.2	Bw
T VIR		
120905		
178	13.5	L
207	13.8	L
213	12.2	Mg
215	13.8	L
R CRV		
121418		
134	13.2	Sl
159	11.9	Sl
162	12.2	Jo
168	12.0	Jo
174	11.3	L
176	12.1	Jo
177	10.9	Sl
178	11.4	Bm
180	10.9	Cy
180	10.8	Sq
R CRV		
121418		
182	10.9	Jo
183	10.5	Jo
184	10.5	Pt
185	10.4	Jo
187	10.2	Jo
187	10.4	Sl
189	10.0	Jo
190	10.2	Je
191	10.3	Cy
191	10.9	Sq
192	10.0	Jo
194	9.7	Jo
197	9.5	Jo
204	8.9	Jo
205	9.3	B
206	9.1	Mc
207	8.8	Mc
207	9.0	L
208	8.8	Sq
209	8.5	An
209	8.9	Oy
209	8.7	Jo
209	8.7	Je
210	8.9	Pt
210	8.8	Hf
211	8.8	Cy
211	8.4	Ad
211	8.8	Sh
211	8.8	Hf
213	8.5	Mc
214	8.7	L
214	8.3	Sq
214	8.5	Hf
215	8.4	Hf
217	8.7	We
217	8.4	Hu
218	8.4	Sh
218	8.4	Hf
221	7.4	Se
222	8.2	Sq
223	8.4	L
223	8.5	Oy
232	8.2	Hf
232	8.2	Sh
234	8.2	Hf
234	8.1	Hu
237	8.2	Sh
SS VIR		
122001		
162	7.5	Jo
168	7.5	Jo
168	7.5	L
179	7.1	L
182	7.6	Jo
182	8.4	Md
184	7.2	Ko
185	7.6	Jo
187	7.5	Jo

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
SS VIR	U CEN	T UMA	S UMA	S UMA	RV VIR
122001	*122854*	123160	123961	123961	*130212*
189 7.5 Sz	151 8.4 En	213 10.2 So	168 9.3 Jo	237 7.2 Sh	234[13.8 Bw
192 7.4 Jo	153 8.2 Ht	214 9.9 Ah	171 9.3 Ch	RU VIR	U OCT
193 7.2 Ko	159 7.8 Bl	217 10.3 Ah	176 9.3 Hf	124204	*131283*
197 7.2 Jo	163 8.1 Ht	218 9.7 Bc	177 8.8 Bc	168 12.9 L	140 12.0 Bl
204 7.2 Jo	167 7.9 Bl	218 9.8 Hf	182 8.6 Jo	179 12.7 L	148 12.9 Ht
206 8.1 Hu	168 8.2 Ht	225 10.7 B	183 8.5 Bc	180 12.8 Cy	153 12.9 Ht
207 6.9 L	173 7.7 Bl	*222* 10.0 Sq	183 8.5 Bf	182 12.7 Br	153 13.3 Bl
209 7.3 Jo	174 7.8 En	225 10.9 Gy	183 8.9 Hf	183 13.0 Bw	163 13.2 Ht
214 7.2 L	177 8.2 Ht	R VIR	184 8.7 Pt	184 12.8 Pt	178 13.6 En
217 8.4 Hu	178 8.1 En	123307	185 8.4 Jo	197 12.7 Bw	183 13.6 En
219 8.0 We	183 8.0 En	134 6.8 Ch	187 8.1 Jo	207 12.5 L	187 13.6 Bl
219 7.4 B	183 8.2 Ht	147 7.4 He	187 8.9 Hf	207 13.0 Bw	W VIR
220 6.9 Pk	187 8.5 Bl	153 7.0 Ch	188 8.6 Ah	210 12.6 Pt	*132002*
221 7.5 Sz	187 8.0 En	162 7.8 Jo	188 8.4 Bc	211 12.4 Cy	221 10.3 Ko
221 7.7 Ko	190 8.2 Ht	168 7.8 Jo	189 8.5 Bc	214 12.3 L	*222* 10.4 Ko
222 7.0 L	192 8.1 Bl	168 8.7 Ah	189 8.6 Ah	216 12.5 Be	233 9.5 Hf
222 7.2 Mg	T UMA	177 9.0 Ah	190 8.5 So	217 12.5 Hu	235 9.6 Hf
234 8.1 Hu	123160	177 9.0 Ch	190 8.5 We	*222* 12.2 Mg	237 9.6 Sh
T CVN	134 8.0 Ch	178 8.5 Ra	191 8.8 Hf	225 12.4 Bw	V VIR
122532	149 8.2 Ch	183 8.9 Jo	191 8.5 Ah	234 12.1 Bw	*132203*
148 9.8 Ch	162 7.8 Jo	184 9.9 Pt	191 8.5 Ch	U VIR	179 12.8 L
162 9.9 Jo	165 8.5 Ch	185 9.1 Jo	192 8.3 Jo	124606	180 12.6 Ch
167 10.2 Ch	168 8.3 Jo	185 9.8 Oy	195 8.6 Ra	151 9.1 Ch	181 12.4 B
168 9.7 Jo	176 8.5 Hf	187 9.5 Jo	195 8.4 Ah	162 8.0 Jo	185 11.9 Cy
180 10.1 Cy	177 7.9 Bc	188 10.1 Ah	197 8.2 Jo	168 8.3 Jo	206 9.0 B
182 10.3 Jo	177 8.8 Th	189 10.2 Ah	203 8.7 Hf	168 8.5 Ah	207 9.3 L
184 8.6 Hu	182 8.5 Br	189 10.3 Sz	204 8.3 Ah	168 8.4 L	211 9.1 Cy
184 9.5 Pt	182 8.4 Jo	189 10.0 B	204 8.0 Jo	177 8.3 Hi	214 9.1 L
190 10.1 Cy	183 8.3 Bc	191 10.2 Ch	204 8.3 Sq	177 8.5 Ah	221 8.4 Ko
207 10.5 Hi	183 8.3 Bf	191 10.2 Ah	207 8.1 Mc	179 8.2 L	*222* 9.0 Mg
210 10.5 Cy	183 8.8 Hf	192 10.1 Jo	209 8.0 Jo	180 8.1 Ch	*223* 8.7 L
210 10.5 Pt	184 8.7 Pt	206 11.0 Mc	210 8.2 Pt	182 8.0 Br	224 9.3 Fn
215 10.6 Hi	185 8.5 Jo	207 11.2 Mc	210 8.5 Ra	183 8.4 Jo	233 9.1 Hf
216 10.7 Gs	187 8.7 Jo	210 11.5 Pt	210 8.7 Gy	184 8.0 Pt	235 9.1 Hf
216 10.8 Hu	187 8.7 Hf	215 10.2 We	210 8.4 Hf	187 8.0 Jo	237 9.2 Sh
224 10.6 Hi	188 8.5 Bc	*221* 11.3 Sz	211 8.0 Sq	188 8.4 Ah	R HYA
230 12.1 Wa	188 8.8 Ah	224 10.4 Ra	211 8.6 Ad	189 8.5 Ah	*132422*
234 11.4 Hu	189 8.9 Ah	234 10.2 Hf	212 8.0 Ah	191 8.5 Ah	137 6.3 Ht
Y VIR	189 8.7 Bc	237 9.7 Sh	212 7.6 We	195 8.6 Ah	140 6.3 Bl
122803	190 9.0 So	RS UMA	213 8.5 So	204 8.9 Ah	148 5.9 Ht
166 13.6 L	190 8.6 We	123459	213 7.9 Mc	207 9.0 Hi	148 5.8 Ch
178 12.1 Bm	191 9.1 Ah	134 11.1 Ch	214 7.8 Ah	207 8.7 L	150 5.3 Bl
179 12.0 L	191 8.9 Hf	151 12.5 Ch	217 7.8 Ah	210 9.0 Pt	151 5.5 Ch
180 11.9 Ch	191 8.9 Ch	155 12.9 Ch	217 8.5 Hu	212 9.1 Ah	152 5.3 En
189 11.4 B	192 8.8 Jo	177 13.5 Bn	218 8.5 Be	214 9.0 L	153 5.9 Ht
207 9.9 L	195 8.7 Ra	177 13.7 Ry	218 8.3 Hf	216 9.4 Hi	155 5.3 Ch
214 9.8 L	195 9.2 Ah	178 13.5 Bm	221 7.7 Sz	217 9.6 Hu	158 5.2 Ch
215 9.6 An	197 9.0 Jo	181 13.6 Ry	222 7.7 Sq	217 8.5 We	159 4.8 Bl
216 9.6 Hu	203 9.3 Hf	182 14.0 Br	224 7.5 Ah	221 9.3 L	163 5.5 Ht
216 9.4 B	204 9.1 Jo	214[13.5 Ry	225 7.5 Gy	222 9.5 Mg	165 4.9 Ch
222 9.6 Mg	204 9.6 Sq	234[12.2 Gy	225 7.4 B	224 9.9 Hi	167 4.8 Bl
223 9.4 L	209 9.3 Jo	S UMA	225 7.5 He	234 10.4 Hu	168 4.5 Ht
U CEN	210 10.0 Pt	123961	226 8.2 So	RV VIR	168 4.7 L
122854	210 9.9 Gy	134 11.2 Ch	232 7.7 Hf	*130212*	169 4.6 Ch
137 9.2 En	210 9.7 Hf	151 10.7 Ch	232 7.5 Sh	151[13.3 Ch	172 4.4 Ch
137 9.3 Ht	211 9.8 Sq	162 9.5 Jo	234 7.5 Hu	185[14.5 Bw	173 4.4 Bl
140 8.7 Bl	212 9.7 Ra		234 7.5 Gy	190[13.8 Bw	175 4.3 Ch
150 8.1 Bl	212 10.0 We		234 7.5 Hf	209[13.6 Bw	176 4.5 We

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J.D.	Est.	Obs.
R HYA		
132422		
177	4.5	Ht
179	4.4	L
179	4.2	Ch
181	4.2	Se
182	4.5	Jo
182	4.2	Ch
182	4.4	En
183	4.2	Se
183	4.2	Ht
184	4.1	Se
184	4.5	Pt
185	4.0	Jo
185	4.0	Se
186	4.0	Se
187	4.0	Se
187	3.8	Jo
187	4.2	Ch
187	4.1	En
187	4.0	Bl
189	4.1	Se
189	4.0	Jo
190	4.2	Ht
191	4.2	Ch
192	3.7	Jo
192	4.2	Se
192	4.3	Bl
194	4.2	Se
197	4.2	Se
197	4.0	Ko
203	4.4	Se
204	4.5	Jo
205	4.4	Be
207	4.7	L
207	4.4	Se
207	4.6	Jo
208	4.4	Be
210	5.0	Pt
210	4.4	Se
210	4.7	Ko
211	4.5	Se
211	5.0	We
214	4.5	Se
215	4.7	Ko
218	4.5	Se
225	4.9	L
S VIR		
132706		
134	12.3	Ch
151	12.2	Ch
153	12.1	Ht
162	12.4	Jo
163	12.0	Ht
168	12.3	Jo
177	11.6	Ht
180	11.7	Ch
183	11.3	Ht
183	12.0	Jo
184	11.4	Pt

J.D.	Est.	Obs.
S VIR		
132706		
185	11.5	En
186	11.0	Sq
187	11.4	Ch
189	11.1	B
189	11.3	Sz
190	11.0	Ht
191	11.1	Sq
191	11.3	Ch
208	10.5	Sq
210	9.9	Pt
213	10.1	B
214	9.9	Sq
216	9.7	Hu
217	9.7	Hu
221	9.7	Sz
222	9.8	Mg
222	10.2	Sq
233	9.9	Hf
234	9.1	Wa
235	9.9	Hf
237	10.0	Sh
RV CEN		
133155		
137	8.2	Ht
140	7.6	Bl
150	7.8	Bl
152	8.0	En
153	8.0	Ht
159	7.8	Bl
163	7.8	Ht
167	7.7	Bl
168	7.6	Ht
173	7.6	Bl
177	7.6	Ht
183	7.6	Ht
183	7.6	En
187	7.7	Bl
190	7.3	Ht
192	7.6	Bl
T UMI		
133273		
166	12.9	L
179	13.6	L
182	13.5	Br
208	14.2	L
223	14.7	L
T CEN		
133633		
137	6.2	Ht
140	6.5	Bl
148	6.2	Ht
150	6.3	Bl
152	6.6	En
153	6.2	Ht
159	6.4	Bl
159	6.2	Sl
163	6.5	Ht
166	6.4	Sl

J.D.	Est.	Obs.
T CEN		
133633		
167	6.6	Bl
168	6.7	Ht
173	7.1	Bl
177	7.2	Ht
180	7.3	Sl
183	8.0	En
183	7.8	Ht
187	7.7	Bl
187	7.8	Sl
190	7.7	Ht
192	7.0	Bl
RT CEN		
134236		
140	11.1	Bl
148	11.3	Ht
150	11.5	Bl
152	11.4	En
153	11.4	Ht
159	11.0	Bl
163	11.2	Ht
167	11.0	Bl
168	10.9	Ht
173	10.8	Bl
177	10.7	Ht
183	10.4	Ht
183	10.4	En
187	10.6	Bl
190	10.4	Ht
192	10.3	Bl
R CVN		
134440		
148	9.1	Ch
162	10.2	Jo
167	10.0	Ch
168	10.4	Jo
177	10.3	Ah
184	10.4	Pt
185	10.0	Oy
189	10.7	Ah
190	10.3	So
206	10.8	Hu
210	11.0	Pt
213	11.7	So
216	11.0	Gs
234	11.4	Hu
RX CEN		
134536		
148	13.1	Ht
152[	13.1	En
153[	13.1	Bl
163[	13.1	Ht
177[	13.1	Ht
183[	13.1	En
187[	13.1	Bl
190[	13.1	Ht
T APS		
134677		
137[	12.7	Ht

J.D.	Est.	Obs.
T APS		
134677		
152[	13.1	En
153[	13.2	Bl
163[	13.2	Ht
177[	13.2	Ht
183[	13.2	En
187	13.5	Bl
190[	13.2	Ht
RR VIR		
135908		
184[	12.8	Pt
215[	12.8	Pt
222[	13.1	Mg
Z BOO		
140113		
151[	13.4	Ch
179[	14.0	L
182[	14.0	Br
206[	13.5	B
221	13.8	L
221	14.0	Be
Z VIR		
140512		
128	14.3	L
166	12.2	L
179	10.7	L
180	10.9	Ch
183	10.8	Jo
184	10.3	Pt
206	9.8	B
207	9.9	L
215	10.0	L
215	9.6	Pt
217	10.3	Hu
222	9.8	Mg
RU HYA		
140528		
153	13.2	Bl
153	13.3	Ht
159	13.2	Bl
163	13.5	Ht
167	13.2	Bl
177	12.9	Ht
183	11.5	Ht
183	11.2	En
187	10.7	Bl
190	9.7	Ht
192	9.0	Bl
R CEN		
140959		
134	9.6	Sl
137	10.5	Ht
137	10.3	En
140	10.3	Bl
148	10.5	Ht
150	10.6	Bl
151	10.5	En
153	10.5	Ht
159	10.6	Bl

J.D.	Est.	Obs.
R CEN		
140959		
159	10.8	Sl
163	10.7	Ht
166	10.8	Sl
167	10.5	Bl
168	10.8	Ht
174	10.5	Bl
177	10.8	Ht
183	10.8	Ht
183	10.7	En
185	10.7	En
187	10.7	En
187	11.0	Sl
187	10.4	Bl
190	10.9	Ht
192	10.6	Bl
U UMI		
141567		
162	7.8	Jo
168	7.8	Jo
168	8.2	Ah
180	8.6	Cy
183	8.0	Jo
184	8.6	Pt
185	8.5	Jo
186	8.7	Sf
187	8.6	Jo
188	8.7	Ah
189	8.8	Ah
189	9.0	Sz
189	8.6	Jo
190	8.4	We
190	9.0	Hf
190	8.7	Cy
192	8.7	Jo
194	8.8	Jo
209	9.2	Jo
210	10.0	Cy
210	9.3	Hf
212	9.0	We
214	9.9	Sf
214	9.7	Ah
215	10.0	Pt
216	10.0	Gs
216	9.8	Hi
217	10.2	Ah
217	10.2	Hu
221	10.2	Sz
223	10.1	B
224	10.2	Hi
234	10.7	Sf
234	10.4	Hu
235	10.1	Hf
S BOO		
141954		
134	9.6	Ch
155	10.5	Ch
162	10.2	Jo
168	11.0	Jo

J.D.	Est.	Obs.
S BOO		
141954		
171	11.7	L
176	12.4	Jo
180	11.7	Ch
182	12.2	Br
182	12.8	Jo
184	12.0	Pt
185	12.2	L
185	12.1	Gy
189	12.2	B
206	13.1	B
207	13.3	L
215	13.3	L
215	12.8	Pt
221	13.2	Be
RS VIR		
142205		
151	11.9	Ch
167	12.2	L
171	12.0	Bm
179	12.6	L
180	12.5	Ch
182	13.1	Br
185	12.2	Bm
186	12.6	Cy
207	12.8	L
213	12.7	B
215	12.9	L
221	13.0	Be
V BOO		
142539a		
134	9.0	Ch
155	9.1	Ch
162	9.0	Jo
168	8.9	Jo
168	9.0	Ah
176	8.8	Jo
177	8.8	We
177	9.2	Ch
177	8.9	Ah
181	9.2	Sf
182	8.7	Jo
184	8.8	Pt
185	8.8	Jo
185	8.9	Oy
186	9.1	Cy
187	8.6	Jo
188	8.8	Ah
188	9.2	Sf
189	8.5	Jo
189	8.8	Ah
191	8.8	Ah
192	8.4	Jo
193	8.9	Sq
194	8.5	Jo
203	9.0	Sf
204	8.9	Sq

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Boo	V LIB	S APS	S SER	RU LIB	S UMI
142539a	*143417*	*145971*	151714	*152714*	153378
206 9.5 GD	209 10.3 Jo	185 10.8 En	179 13.5 L	235 10.4 Bw	209 8.2 Sq
207 8.6 Mc	212 10.1 Cy	187 10.4 En	186 13.5 Bw	236 10.5 Hu	212 8.3 We
209 9.3 Oy	215 10.2 L	187 10.6 Bl	189 13.3 Bw	R NOR	212 8.5 Ko
210 8.9 Sq	S LUP	190 10.4 Ht	189 13.6 Ch	*152849*	212 8.5 Ah
211 9.1 Sh	*144646a*	192 10.6 Bl	197 13.5 Bw	152 9.9 En	214 8.6 Hf
211 9.0 Hf	152[12.1 En	RT LIB	207 13.5 Bw	153 10.0 Ht	214 8.6 Sf
211 9.1 Cy	163[12.1 Ht	*150018*	209 13.5 L	153 9.6 Bl	215 8.4 Pt
212 8.8 Ah	177[12.1 Ht	184 9.7 Pt	215 13.2 Pt	159 9.1 Bl	*222* 8.5 Sq
213 8.7 Mc	185[12.1 En	185 10.5 Bw	217 13.3 L	163 9.5 Ht	*222* 8.6 Ko
213 8.9 B	190[12.1 Ht	210 12.2 Bw	221 13.5 Be	167 8.9 Bl	*232* 8.7 Sh
214 8.9 Hf	X LUP	215 12.1 Pt	S CRB	168 9.0 Ht	233 8.7 Hf
215 9.1 An	*144646b*	217 12.0 Hu	151731	174 8.5 Bl	234 9.3 Sf
215 9.2 We	177[12.1 Ht	225 13.0 Bw	151 12.4 Ch	177 8.5 Ht	234 8.7 Hu
215 8.8 Pt	190[12.1 Ht	235[13.0 Bw	180 12.5 Ch	183 8.5 Ht	U LIB
216 9.0 Ra	U Boo	T LIB	184 12.6 Pt	185 9.0 En	*153620a*
217 8.9 Ah	144918	*150519*	189 12.8 Ch	188 8.8 Bl	188[12.9 Bl
217 8.9 Sq	151 10.7 Ch	138[13.2 Ch	215 12.9 Pt	190 8.6 Ht	T NOR
217 9.8 GD	186 10.6 Cy	166 14.4 L	216 13.8 B	192 8.6 Bl	*153654*
221 9.2 Sf	186 10.9 Bw	184[13.2 Pt	RS LIB	X LIB	137 7.4 Ht
224 9.1 GD	187 10.6 Ch	215[13.0 Pt	*151822*	*153020*	153 7.8 Ht
224 8.9 Ah	189 12.0 Jo	Y LIB	136 8.3 En	168 12.8 L	163 8.0 Ht
225 9.1 GD	212 10.8 Cy	*150605*	153 8.7 Bl	185[13.6 L	168 8.6 Ht
232 8.8 Hf	216 11.6 B	168 8.7 L	155 9.4 En	221[14.0 Be	177 8.7 Ht
232 9.0 Sh	234 11.7 Bw	179 8.7 L	159 8.8 Bl	W LIB	183 9.1 Ht
239 9.0 Sf	Y LUP	184 9.0 Pt	163 9.8 En	*153215*	188 9.3 En
R CAM	*145254*	185 8.6 Oy	167 9.5 Bl	138 10.0 Ch	190 10.1 Ht
142584	140 10.7 Bl	185 8.7 We	168 9.5 L	166 12.2 L	Z LIB
182 12.9 Br	150 10.9 Bl	186 8.9 Cy	174 9.8 Bl	179 12.7 L	*154020*
190 11.4 Cy	152 11.3 En	207 9.2 L	179 10.3 L	189 13.5 Ch	188[12.7 Bl
211 9.6 Cy	159 11.6 Bl	209 9.2 Oy	183 10.8 Ht	209[13.4 L	R CRB
223 9.6 B	163 12.5 Ht	212 9.0 Cy	183 10.2 Jo	213[11.3 An	154428
236 9.3 Md	167 11.6 Bl	215 9.8 Pt	187 10.6 En	221[14.0 Be	075 5.9 Km
R Boo	174 11.6 Bl	215 9.3 L	188 10.2 Bl	S UMI	096 5.9 Km
143227	177 12.6 Ht	216 9.5 Hf	190 11.0 Ht	153378	107 6.0 Km
134 8.8 Ch	183 12.7 Ht	217 9.6 Hu	192 10.6 Bl	134 10.4 Ch	123 5.9 Km
155 9.9 Ch	183 13.0 En	217 8.2 We	207 11.4 L	149 10.2 Ch	123 5.9 Hr
162 10.0 Jo	187 12.4 Bl	220 9.6 Pk	215 11.7 L	162 8.6 Jo	127 5.9 Hr
176 10.6 Jo	190 12.9 Ht	223 9.6 Oy	217 11.5 Hu	168 8.5 Jo	128 5.9 Hr
177 11.8 Ah	S APS	224 9.7 B	223 11.6 L	176 9.3 We	130 6.3 Kd
182 11.0 Jo	*145971*	234 10.2 Hu	226 11.5 B	180 8.7 Ko	130 5.9 Hr
184 11.9 Pt	134 10.6 Sl	V CRB	236 11.6 Hu	181 9.5 Sf	131 5.9 Hr
185 11.3 Jo	137 10.4 Ht	151432	RU LIB	183 9.0 Ch	133 6.0 Ch
187 11.4 Jo	140 10.7 Bl	204 8.5 Sq	*152714*	183 8.5 Jo	135 6.0 Hr
189 12.3 Ah	149 10.8 En	210 8.0 Sq	138 13.2 Ch	184 8.5 Pt	139 6.1 Ch
189 11.7 Ch	150 10.8 Bl	S LIB	185 12.8 Bw	185 8.5 Jo	140 5.9 Hr
215 12.9 Pt	152 10.4 En	*151520*	187 13.3 L	186 8.6 Ko	149 6.1 Ch
216 12.7 B	153 10.4 Ht	138 11.0 Ch	189 12.8 Ch	187 8.7 Jo	156 6.0 Lg
V LIB	159 10.7 Bl	168 12.5 L	190 12.5 Bw	188 8.6 Ah	156 6.0 Ch
143417	159 10.7 Sl	179 12.5 L	208 11.3 L	188 9.0 Sf	162 5.8 Jo
167 13.4 L	163 10.5 Ht	184 12.5 Pt	210 11.1 Bw	189 8.3 Jo	164 6.0 Ko
180 11.9 L	163 11.0 En	187 11.8 Ch	213 11.2 An	189 8.7 Ah	164 5.9 L
182 11.2 Jo	167 10.7 Bl	207 11.2 L	215 10.9 L	192 8.3 Jo	165 6.0 Ch
185 11.3 Jo	168 10.4 Ht	215 10.4 L	215 11.0 Pt	193 8.6 Ko	166 6.0 L
192 10.6 Jo	174 10.7 Bl	215 10.4 Pt	223 10.5 L	193 8.6 Sq	167 5.9 Ko
204 10.4 Jo	177 10.5 Ht	223 10.1 L	225 10.8 Bw	194 8.2 Jo	167 6.0 L
206 10.1 B	178 10.8 En	S SER	226 10.8 B	203 8.5 Sf	168 6.0 L
207 10.0 L	183 10.5 Ht	151714		204 8.0 Jo	168 6.2 Ah
	184 10.6 Sl	167 13.0 L		209 8.2 Jo	168 6.1 Jo

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CrB	R CrB	R CrB	R CrB	R CrB	V CrB
154428	154428	154428	154428	154428	154639
169 5.8 Ch	186 5.9 L	204 6.3 Ba	214 5.9 L	224 6.0 Je	176 8.8 Jo
171 6.0 Ko	186 5.8 Pt	204 6.1 Ah	214 6.1 Se	224 6.0 Mg	182 8.9 Jo
171 6.0 L	187 6.0 Jo	205 6.0 Be	215 6.0 Se	224 6.0 Pt	184 9.0 Pt
174 6.0 Ko	187 6.2 Se	206 5.8 Mc	215 5.9 Pt	225 5.9 Pt	185 8.8 Jo
176 5.9 Jo	187 6.0 Hf	206 5.9 We	215 6.1 L	225 6.0 Gy	185 10.2 Cy
176 6.0 Cy	187 5.9 L	206 5.9 Hr	215 6.0 Hf	225 6.0 He	187 8.8 Jo
176 6.0 We	187 5.8 Pt	206 6.0 Bg	215 6.1 An	226 6.2 Ba	189 10.0 Ah
176 6.0 L	187 5.9 Ba	206 5.9 Hu	215 6.0 Ko	226 6.0 Hf	189 10.3 Md
176 5.9 Ra	187 6.0 Hr	207 6.0 Jo	216 6.0 Ko	226 6.0 Pt	189 9.0 Jo
176 5.9 Hr	188 6.1 Ah	207 5.9 Mc	216 6.0 Se	227 6.2 Ba	189 9.8 Ch
177 6.0 Mg	188 6.0 Bc	207 6.0 Cy	216 6.0 Be	228 6.0 Sh	190 10.2 So
177 6.1 Ah	188 6.0 Hf	207 6.3 Ba	216 6.2 An	230 6.3 Ba	192 8.8 Jo
177 6.0 Bg	188 5.9 Ra	207 6.0 L	216 5.5 Rb	230 6.0 Wa	194 9.2 Jo
178 6.0 He	189 6.1 Ah	207 5.9 Se	216 6.0 Cy	231 6.0 Pt	196 9.0 Sq
179 6.0 L	189 6.0 Cy	208 6.3 Ba	216 5.8 Hu	231 6.0 Ra	204 9.2 Jo
179 5.6 Ch	189 5.8 Ko	208 6.0 L	217 5.6 Rb	232 6.0 Pt	204 9.7 Sq
179 5.9 Hr	189 6.2 Se	208 6.0 Ra	217 5.7 Hu	232 6.3 Ba	207 9.0 Jo
180 6.0 Je	189 6.1 Sz	209 6.0 Oy	217 6.0 L	232 6.0 Bg	209 8.7 Jo
180 6.0 Cy	189 5.9 Bg	209 5.8 Jo	217 6.0 He	233 6.3 Ba	210 8.4 Sq
180 5.9 Ko	189 5.8 Pt	209 6.0 Je	217 6.4 Ah	233 5.9 Pt	212 9.8 Cy
180 6.0 Ra	189 5.8 Ch	209 6.0 Pt	218 6.0 Se	234 6.0 Hu	214 10.2 So
180 5.9 Hr	189 5.8 Jo	209 6.0 L	218 6.0 Gy	234 6.0 Gy	214 9.7 Ah
181 6.0 Se	189 5.9 Ba	210 6.0 Cy	218 6.0 Hf	234 6.3 Ba	215 8.5 Pt
181 5.9 Bg	189 6.0 Hr	210 6.1 Mg	218 5.9 Pa	235 6.3 Ba	216 9.2 B
181 6.0 Pt	189 6.0 Bc	210 6.0 Pt	218 6.0 Ko	236 5.7 Hu	R LIB
182 6.0 Jo	190 6.0 Hr	210 6.0 L	218 5.9 Bc	237 6.0 O	*154715*
183 5.8 Bc	190 6.0 Cy	210 5.9 Se	218 5.7 Rb	237 5.9 Bg	138 10.5 Ch
183 5.5 Ko	190 5.8 Ko	210 6.0 Gy	218 6.1 Cy	238 5.8 Hu	168 11.0 L
183 6.0 Se	190 5.8 We	210 6.1 Hf	218 5.9 Pt	X CrB	179 11.4 L
183 5.9 Bg	190 6.0 Hf	210 6.0 Ko	218 6.0 L	154536	189 12.2 Ch
183 5.9 Gy	190 5.8 Pt	211 6.1 Sh	219 6.0 Rb	151 13.0 Ch	208 13.0 L
183 6.0 Hf	191 6.1 Ah	211 6.0 Be	219 6.4 Gs	179 13.1 L	221 13.9 L
183 5.9 Pt	191 5.8 Ko	211 6.0 Hf	219 6.1 Cy	184 13.3 Pt	234 13.8 Bw
183 5.8 Ba	191 6.0 Cy	211 6.1 An	219 5.9 Ko	189 13.6 Ch	R LUP
184 6.0 Cy	191 5.9 Hr	211 6.0 Ko	220 6.0 He	207 12.8 L	*154736*
184 6.2 Se	192 6.0 Gs	211 5.9 Ad	220 6.0 Je	215 12.8 Pt	166 9.7 Sl
184 5.8 Hu	192 6.0 Hf	211 6.1 Cy	220 6.2 Mg	215 12.7 L	187 10.5 Sl
184 5.8 Lg	192 5.9 Ch	211 6.0 Se	221 6.1 Sz	216 12.9 B	188 10.0 En
184 5.7 Pt	192 6.0 Jo	212 6.2 Ah	221 6.0 We	217 12.7 Hi	RR LIB
185 6.0 Cy	192 6.0 Cy	212 6.0 Cy	221 6.0 L	224 12.4 Hi	*155018*
185 6.0 Jo	193 5.8 Ko	212 6.3 Bh	221 6.0 Se	R SER	166 8.7 L
185 5.8 Ko	194 6.0 Jo	212 5.9 Ko	221 5.9 Ko	154615	179 9.4 L
185 6.1 Se	194 5.9 Ba	212 6.1 Mg	222 6.0 Ko	162 10.0 Jo	184 9.8 Pt
185 6.1 Gy	194 6.0 Se	212 5.9 Pt	222 6.0 Je	177 11.3 Ch	207 11.2 L
185 6.0 Hf	196 5.9 Hr	213 5.9 Mc	222 6.0 Rb	183 10.3 Jo	215 11.9 L
185 6.0 L	196 6.1 Sh	213 6.3 Bh	222 6.2 Mg	184 11.5 Pt	215 11.9 Pt
185 5.9 Oy	197 5.8 Jo	213 6.1 Mg	222 6.0 Pt	185 11.2 Cy	225 12.2 Bw
185 5.8 Pt	197 6.0 Se	213 5.9 Pt	223 6.0 L	186 10.5 Jo	226 12.6 B
185 6.0 Hr	197 5.9 Ko	213 5.9 L	223 6.0 Pt	190 11.8 Md	235 13.4 Bw
186 6.0 Hr	198 5.9 Hr	213 6.1 Ra	223 6.1 Oy	191 11.8 Ch	Z CrB
186 6.1 Mg	200 5.9 Hr	213 6.1 An	223 6.0 Bc	212 12.1 Cy	155229
186 5.9 Ba	201 6.0 Je	213 5.9 Ko	223 6.0 Bf	215 11.9 Pt	166 14.2 L
186 6.2 Bc	202 6.0 Be	214 6.2 Ah	223 5.9 Bg	223 12.7 B	185 11.0 L
186 6.0 Cy	202 5.9 Hr	214 6.0 Be	224 6.0 Bg	V CrB	189 11.1 Ch
186 6.0 He	203 6.0 Hf	214 6.0 Ko	224 6.0 Bc	154639	189 10.9 Md
186 5.8 Ko	203 6.1 Se	214 6.0 Je	224 6.0 Bf	151 10.2 Ch	190 10.8 Cy
186 6.2 Se	203 6.0 He	214 6.0 Cy	224 6.3 Ah	162 8.8 Jo	207 10.0 L
186 5.9 Gy	204 6.1 Jo	214 6.0 Mg	224 6.0 Be	168 8.9 Jo	212 10.4 Cy

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z CrB	SX Her	RU Her	V Oph	U Her	W Her
155229	160325	160625	*162112*	162119	163137
217 9.9 L	185 8.0 Ko	217 13.6 L	185 7.5 Pt	218 9.7 Gy	151 8.6 Ch
223 9.7 B	185 8.5 Jo	221 13.8 Be	187 7.3 Jo	218 10.0 Pt	162 8.8 Jo
RZ Sco	185 7.9 L	235 13.4 Bw	189 7.5 Ch	223 9.5 Oy	168 9.0 Jo
155823	185 7.9 Pt	R Sco	189 7.3 Jo	225 9.7 Gy	171 9.6 BR
136 12.6 Ht	186 7.8 Pt	*161122a*	192 7.3 Jo	228 9.7 Sh	175 9.8 BR
155 12.6 Ht	186 8.0 Ko	171 13.2 Bm	193 7.5 Ra	232 9.8 Sh	176 9.1 Jo
163 12.2 Ht	187 8.5 Jo	183 12.7 Ht	207 7.6 L	232 9.9 Hf	177 9.3 Th
183 11.0 Ht	187 8.0 Pt	185 12.4 Bm	208 7.6 Ra	234 9.8 Gy	180 10.0 BR
184 10.1 Pt	188 8.3 Hf	185 12.7 Pt	209 7.4 Jo	234 10.2 Sf	180 9.7 Ko
188 10.4 En	189 7.8 Pt	188 12.3 Bl	211 7.6 Ad	234 10.4 Hu	181 10.0 BR
190 10.2 Ht	190 7.8 Pt	188 12.1 En	215 7.4 L	Y Sco	182 9.3 Jo
215 8.9 Pt	191 8.2 Hf	190 12.3 Ht	217 7.7 Ra	*162319*	185 10.1 Pt
235 9.0 O	193 8.1 Ko	192 11.8 Bl	218 7.5 Pt	185 11.7 L	185 9.4 Jo
Z Sco	194 8.3 Jo	192 10.3 Jo	219 7.2 We	208 13.1 L	185 10.1 BR
160021	197 8.3 Jo	209 10.5 Jo	221 7.7 Sz	221 13.5 L	186 10.0 Bw
136 11.9 Ht	203 8.5 Hf	218 11.1 Pt	225 8.0 B	SS Her	187 9.5 Jo
155 11.7 Ht	204 9.1 Sq	S Sco	235 8.0 O	162807	187 10.1 BR
163 11.5 Ht	205 8.7 Pt	*161122b*	U Her	152 9.0 Ch	189 9.9 Ch
166 11.4 L	207 8.5 L	163 12.8 Ht	162119	162 8.9 Jo	189 9.2 Jo
179 11.2 L	209 8.6 Pt	171 13.2 Bm	162 8.0 Jo	168 9.3 Jo	190 10.2 BR
183 11.6 Ht	209 9.1 An	183 12.3 Ht	168 7.9 Jo	171 9.9 L	192 9.4 Jo
188 11.0 Bl	210 8.7 Pt	185 12.5 Pt	168 8.4 Ah	182 10.3 Jo	193 10.0 Ko
188 10.9 En	211 8.9 Sq	185 12.3 Bm	177 8.6 Ah	185 10.5 Jo	194 9.6 Jo
190 11.4 Ht	212 8.7 Ko	188 12.2 Bl	177 8.6 Ch	185 11.4 L	197 9.7 Jo
192 11.0 Bl	212 8.4 Pt	188 12.0 En	182 8.5 Jo	185 11.7 Pt	204 10.0 Jo
207 10.8 L	215 8.5 Pt	190 12.3 Ht	183 9.2 Gy	189 11.6 Cy	209 10.5 Jo
215 10.9 L	215 8.5 L	192 12.1 Bl	185 8.7 Jo	189 11.5 Ch	212 11.1 Ko
217 10.5 Hu	215 8.4 Hf	218 11.5 Pt	185 8.9 Oy	189 11.4 Jo	213 10.4 We
234 10.0 Hu	218 8.4 Pt	234 11.3 Bw	185 9.3 Sf	190 10.8 We	215 11.5 B
236 10.0 Hu	221 8.0 Ko	W CrB	185 8.6 We	192 11.6 Jo	218 11.9 Pt
R Her	222 8.1 Ko	161138	185 8.8 Pt	207 12.1 L	222 11.1 Ko
160118	222 8.2 Pt	185 12.7 Jo	187 8.6 Jo	213 10.8 We	235 12.2 Bw
185 14.2 Bw	223 8.1 Pt	185 11.8 Bw	188 9.1 Hf	215 12.4 B	R UMi
207 14.2 Bw	223 8.3 L	185 12.1 Pt	188 9.1 Ah	215 12.6 L	163172
215 13.5 B	224 8.0 Pt	187 12.5 Jo	189 9.1 Ah	218 12.4 Pt	162 9.0 Jo
218 12.8 Gy	225 7.9 Pt	189 11.4 Sz	189 9.3 Cy	223 12.2 L	167 9.1 L
U Ser	226 8.0 Pt	189 11.4 Md	189 8.5 Jo	239 11.2 Sf	168 9.1 Jo
160210	231 8.0 Pt	192 12.4 Ch	191 9.2 Ch	T Oph	176 9.0 Jo
184 12.3 Pt	232 8.0 Pt	215 10.2 B	192 8.7 Jo	*162815*	182 8.9 Jo
215 12.3 Pt	233 7.9 Pt	218 10.5 Pt	192 9.1 Hf	138 10.8 Ch	185 9.0 Jo
223 12.2 B	234 8.0 Pt	221 9.3 We	194 9.1 Hf	171 9.4 L	186 9.2 L
234 11.5 Hu	235 8.1 Hf	235 8.5 Hf	194 8.7 Jo	185 9.4 L	187 9.1 Jo
X Sco	W Sco	W Oph	196 9.3 Sh	185 9.4 Pt	188 9.3 Bc
160221a	*160519*	*161607*	203 9.3 Hf	188 9.0 Bl	189 9.0 Bc
168 12.7 L	188 12.3 Bl	152 11.0 Ch	204 9.3 Jo	193 9.0 Bl	189 8.8 Jo
185 13.8 L	192 12.2 Bl	168 11.6 L	207 9.2 Jo	208 9.7 L	190 9.0 We
210 14.0 L	RU Her	179 12.0 L	209 9.4 Jo	215 10.2 L	191 9.4 Hf
221 14.3 L	160625	185 12.6 Pt	210 9.2 Gy	218 10.8 Pt	193 9.5 Sq
SX Her	152 13.0 Ch	208 13.1 L	210 9.6 Hf	223 10.5 L	194 8.9 Jo
160325	168 13.8 L	189 12.1 Ch	211 9.8 Hf	234 11.6 Bw	197 8.9 Jo
168 7.8 L	184 13.5 Pt	215 13.2 L	212 9.5 Cy	S Oph	203 9.4 Hf
179 8.2 L	185 13.8 L	V Oph	212 9.6 Ah	*162816*	204 8.9 Jo
180 7.8 Ko	185 13.4 Bw	*162112*	213 9.5 Fd	166 14.4 L	207 9.0 Jo
181 8.0 Pt	189 13.4 Ch	152 8.0 Ch	213 10.0 We	185 14.7 L	208 9.1 L
182 8.5 Jo	197 13.4 Bw	168 7.5 L	214 9.7 Sf	210 14.2 L	209 9.0 Jo
183 8.0 Pt	210 13.8 L	179 7.3 L	215 9.5 B	221 13.7 L	210 9.1 Sq
184 8.0 Pt	215 12.8 Pt	182 7.3 Jo	216 9.7 Sh		212 9.0 We
184 7.9 Ko	215 14.1 B	185 7.4 Jo	217 9.5 Hi		216 9.2 Hf

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R UMi	RS Sco	R Oph	Z Oph	W Pav	T Her
163172	*164844*	*170215*	171401	*174162*	180531
218 9.5 Bc	136 7.2 Ht	209 9.6 Jo	217 9.2 Ah	136 11.5 Ht	162 7.9 Jo
218 9.1 L	153 7.6 Bl	213 12.2 Fd	221 9.0 We	140 11.6 Bl	168 8.2 Jo
221 9.2 Sq	159 7.7 Bl	215 12.1 L	222 8.6 Pt	150 12.5 Bl	171 8.2 L
234 9.6 Hf	163 7.9 Ht	218 11.7 Gy	224 9.0 Ah	163 12.7 Ht	172 8.5 Ah
234 9.4 Hu	167 7.9 Bl	222 11.8 Pt	234 8.4 Hf	183[13.0 Ht	177 8.5 Ah
R Dra	174 8.1 Bl	223 11.6 L	236 8.7 Hu	193[13.0 Bl	182 8.7 Jo
163266	183 8.9 Ht	225 11.8 Gy	237 9.0 O	RS Oph	183 8.7 Gy
151 12.0 Ch	188 8.6 En	234 10.6 Gy	RS Her	*174406*	185 8.6 Gy
162 12.3 Jo	188 8.6 Bl	236 10.6 Hu	171723	186 11.0 Pt	185 8.5 We
168 12.3 Jo	190 9.1 Ht	RT Her	162 8.2 Jo	222 11.1 Pt	185 8.4 L
176 12.6 Jo	193 8.6 Bl	170627	168 8.5 Jo	U Ara	186 8.2 Pt
182 12.5 Jo	RR Sco	152 11.3 Ch	177 8.9 Ah	*174551*	186 8.9 Jo
185 12.5 Jo	*165030a*	162 10.2 Jo	182 8.7 Jo	136[13.0 Ht	188 8.7 Ah
185 12.1 Pt	136 11.8 Ht	168 9.7 Jo	186 8.9 Jo	183 12.8 Ht	189 8.7 Ah
187 12.6 Jo	155 12.1 Ht	171 10.7 BR	186 9.1 Pt	190 11.7 Ht	189 8.5 Jo
189 12.6 Jo	163 12.2 Ht	177 10.3 BR	188 9.2 Ah	RT Oph	191 8.8 Ah
190 12.9 Ma	166 12.2 Sl	180 10.2 BR	189 9.2 Ah	175111	195 9.2 Ah
191 12.2 Ch	167 11.8 Bl	182 9.6 Jo	189 9.2 Jo	166[14.4 L	197 8.8 Jo
192 12.6 Jo	183 11.4 Ht	184 10.5 Ko	**192 9.3 Jo**	215 13.7 L	204 9.7 Jo
197 12.5 Jo	188 11.4 Bl	185 10.1 Pt	194 9.5 Jo	223 13.7 L	209 10.8 Jo
204 12.3 Jo	188 11.3 Sl	185 10.2 BR	197 9.5 Jo	237 13.5 Bw	209 9.8 Je
209 12.5 Jo	190 11.2 Ht	186 9.7 Jo	204 9.6 Jo	T Dra	209 10.5 L
222 11.9 Pt	193 11.1 Bl	187 10.1 BR	209 10.0 Jo	175458a	210 10.2 Gy
RR Oph	237 9.0 O	188 10.1 BR	214 10.8 Ah	136 9.5 Ch	211 9.9 An
164319	SS Oph	189 9.9 Th	216 11.0 Cy	139 9.7 Ch	212 11.0 Ah
167 11.2 L	*165202*	189 9.2 Ch	222 12.0 Pt	190 10.8 Ch	212 10.6 Ra
171 11.5 Bm	192 8.8 Jo	189 9.4 Jo	225 11.5 B	UY Dra	216 11.1 Cy
179 11.7 L	197 8.6 Jo	190 9.8 We	S Oct	175458b	218 11.3 L
184 11.6 Ko	216 7.9 Cy	192 9.4 Jo	*172486*	136 12.2 Ch	218 11.7 Gy
185 12.0 Pt	219 9.8 We	193 10.0 Ko	134 13.0 Sl	139 12.2 Ch	222 12.3 Pt
185 12.0 Bm	222 9.0 Pt	194 9.4 Jo	148[13.0 Ht	190 11.8 Ch	225 12.5 Gy
207 12.7 L	236 8.9 Md	197 9.5 Jo	153[13.0 Bl	RY Her	W Dra
215 12.9 L	RV Her	204 9.4 Jo	163[12.8 Ht	175519	180565
223 13.8 L	165631	206 10.0 Hu	177[13.0 Ht	139 13.8 Ch	162 10.0 Jo
S Her	152 13.4 Ch	209 9.5 Jo	183 13.0 Ht	166 13.9 L	171 10.4 L
164715	168 14.2 L	221 10.5 Sf	187 13.0 En	185 12.9 L	183 10.0 Jo
162 8.5 Jo	185 14.2 Bw	221 10.7 Ko	190[12.8 Ht	186 13.2 Pt	186 10.0 Jo
168 8.7 Jo	186 14.2 L	222 11.0 Pt	RU Oph	190 12.8 Ma	186 10.7 L
177 8.6 Ah	190 14.3 Bw	226 11.0 B	172809	209 11.5 L	186 10.2 Pt
177 9.0 Ch	207 13.5 Bw	235 11.1 Bw	168 12.7 L	215 11.3 L	197 10.2 Jo
182 9.1 Jo	209 13.7 L	239 11.3 Sf	185 13.1 L	222 11.6 Pt	209 10.8 Jo
185 9.4 Jo	213 13.2 B	RW Sco	186 13.2 Pt	223 10.8 L	209 11.0 L
185 9.8 Pt	215 13.0 L	*170833*	190 13.9 Ma	232 10.2 O	218 12.0 L
186 9.5 Bw	222 12.5 Pt	188[12.5 Bl	210 13.8 L	V Dra	222 12.1 Pt
187 9.6 Jo	223 12.7 L	Z Oph	221 13.7 L	175654	X Dra
188 9.4 Ah	235 11.6 Bw	171401	222 13.0 Pt	139 11.2 Ch	180666
189 9.6 Ah	RT Sco	183 10.6 Jo	234 12.4 Md	171 9.6 L	171 11.6 L
189 10.2 Jo	*165636*	185 11.2 Pt	RT Ser	186 9.8 L	185 11.5 L
190 9.8 We	188 9.2 Bl	186 10.4 Jo	*173411*	186 9.8 Pt	186 10.0 Jo
191 9.1 Ch	193 9.9 Bl	**189 10.3 Jo**	166 12.9 L	209 10.4 L	186 10.6 Pt
192 9.8 Jo	R Oph	190 11.3 Cy	208 13.0 L	217 10.9 L	197 10.4 Jo
197 9.7 Jo	*170215*	194 9.9 Jo	221 12.7 L	222 10.8 Pt	209 11.0 Jo
210 11.0 Bw	136 12.5 Ch	204 9.7 Jo	RU Sco	R Pav	209 11.2 L
212 10.7 Ah	167 13.2 L	206 9.6 Hu	*173543*	*180363*	218 11.5 L
213 10.0 We	185 13.2 L	209 9.2 Jo	188 13.1 Bl	136 11.3 En	222 11.5 Pt
215 10.7 B	189 11.7 Jo	212 9.8 Cy	SV Sco	163 12.1 En	
216 11.3 Cy	192 11.5 Jo	213 9.6 Fd	*174135*	190 12.6 Ht	
222 11.0 Pt	208 12.5 L	214 9.2 Ah	193 11.9 Bl		

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
TV HER	T SER	RY LYR	R SCT	ST SGR	RX SGR
181031	182306	184134	*184205*	*185512a*	*190818*
186[11.0 L	136 12.5 Ch	139 11.8 Ch	221 6.7 We	139[12.5 Ch	136 9.8 Ht
218[13.5 L	182 10.9 Jo	167 12.7 L	221 6.0 L	177 14.0 L	169 10.9 Ch
RY OPH	186 10.8 Pt	185 13.2 L	221 6.0 Se	223[14.5 L	171 10.9 L
181103	189 11.2 Jo	218 14.1 L	222 6.3 Pt	R CRA	186 11.8 L
186 11.7 Pt	192 11.0 Jo	R SCT	223 6.2 Pt	*185537a*	190 11.8 Pt
190 12.0 Cy	204 11.0 Jo	*184205*	223 6.3 Ra	136 12.5 Ht	190 12.1 Ht
221 11.0 We	209 10.8 Jo	134 5.7 Ch	223 6.3 Oy	163 11.5 Ht	*220* 13.3 L
222 13.2 Pt	219 10.0 We	140 5.7 Ch	223 6.3 Bc	166 11.7 Sl	RW SGR
W LYR	222 11.0 Pt	166 5.6 Sl	223 6.3 Bf	186 11.2 Ht	*190819a*
181136	SV DRA	167 5.5 L	224 6.0 Bc	187 10.6 Sl	134 10.8 Ch
162 7.7 Jo	183149	179 6.1 L	224 6.0 Bf	190 11.1 Ht	136 9.7 Ht
168 8.0 Jo	168 12.6 L	180 6.7 Cy	224 5.9 Mg	T CRA	169 10.6 Ch
168 7.7 Ah	186 13.7 L	184 6.8 Cy	224 6.3 Pt	*185537b*	171 10.3 L
171 7.9 L	190 14.2 Ma	185 6.7 Cy	224 6.5 GD	136 12.5 Ht	186 9.6 L
172 7.9 Ah	*209* 13.8 L	185 6.1 Jo	225 6.5 GD	163 12.3 Ht	190 9.0 Pt
177 8.3 Ah	218[13.6 L	185 6.5 Pt	225 6.1 Gy	166 12.8 Sl	190 9.5 Ht
182 8.3 Jo	RZ HER	185 6.5 Hr	226 6.3 Pt	186 12.5 Ht	208 9.4 L
185 8.3 Jo	183225	186 6.8 Cy	226 6.0 Hf	188 13.3 Sl	*220* 9.4 L
185 8.2 L	168 12.7 L	186 7.0 Se	231 5.8 Pt	Z LYR	*222* 9.1 Pt
186 9.0 Pt	185 13.7 L	186 6.4 L	232 5.6 Pt	185634	TY AQL
187 8.3 Jo	215[13.3 L	187 6.5 Sl	234 5.7 Gy	139 11.7 Ch	*190907*
188 8.7 Ah	237[13.3 Bw	189 6.0 Jo	234 5.8 Hf	189 12.9 Pt	*222* 10.3 Pt
189 8.8 Ah	X OPH	189 6.7 Hr	235 5.8 Pt	*222* 13.1 Pt	S LYR
189 8.6 Jo	183308	190 6.8 Cy	236 5.5 Bg	SU SGR	190925
191 8.9 Ah	136 6.7 Ch	190 6.9 Se	237 5.4 Bg	*185722*	140 13.6 Ch
192 8.6 Jo	162 6.6 Jo	190 6.4 Pt	238 5.4 Bg	136 9.1 Ht	167 11.6 L
195 9.0 Ah	168 7.0 Jo	190 6.5 Ma	NOV AQL	190 8.9 Ht	186 12.1 L
197 9.0 Jo	171 6.8 L	191 6.8 Cy	184300	RT LYR	190 11.7 Pt
201 9.8 Je	182 7.5 Jo	191 7.1 Ra	139 10.5 Ch	185737	208 12.2 L
204 9.9 Jo	184 6.9 Ko	191 7.3 Hr	182 11.2 Jo	140[13.9 Ch	210 12.1 Gy
207 10.0 Jo	185 7.3 We	192 6.8 Cy	185 11.0 Jo	186 13.9 L	218 12.4 Gy
209 10.2 Jo	185 7.2 Jo	192 6.0 Jo	185 11.5 Pt	208 12.9 L	219 12.3 L
209 10.0 Je	185 7.3 Cy	193 7.1 Ch	189 11.1 Jo	218 12.3 L	222 12.4 Pt
209 10.3 L	185 6.8 L	196 6.4 Hr	190 11.5 Pt	R AQL	225 12.4 Gy
211 10.4 An	186 7.4 Pt	197 6.7 Se	204 11.2 Jo	190108	X LYR
214 10.6 So	188 7.5 Ra	197 6.2 Jo	209 11.4 Jo	136 11.5 Ch	190926
214 10.7 Ah	189 6.9 Jo	204 6.2 Jo	212 11.6 Pt	183 8.8 Jo	190 8.9 Pt
214 10.5 Je	192 6.8 Jo	206 6.1 We	222 11.5 Pt	184 8.9 Ko	*222* 8.6 Pt
216 12.1 Cy	197 7.0 Jo	207 6.4 Jo	225 10.9 Gy	189 9.2 Pt	RS LYR
218 11.0 L	204 7.2 Jo	207 6.5 Mc	234 10.6 Gy	190 9.0 Cy	190933a
220 11.0 Je	208 7.3 L	207 6.3 L	RX LYR	212 7.7 Ah	167 14.0 L
222 11.0 Je	208 7.5 Ra	208 6.8 Ra	185032	214 7.7 Ah	186 14.2 L
222 11.9 Pt	209 7.4 Jo	209 6.2 Jo	139[13.0 Ch	217 7.3 Ah	209 14.0 L
SV HER	*209* 7.3 Oy	210 6.8 Cv	167 14.5 L	219 9.0 We	218 13.8 L
182224	211 7.7 Ad	210 6.5 Pt	189 13.5 Pt	219 7.3 Ra	RU LYR
168 14.0 L	212 7.5 Cy	210 6.0 Gy	208 12.7 L	221 6.8 Ko	190941
185 13.2 L	*212* 7.6 Ra	211 6.3 Ma	218 12.4 L	*222* 6.4 Pt	140 13.4 Ch
186 12.7 Pt	217 6.9 We	212 6.8 Cy	*222* 12.0 Pt	223 6.8 Ra	186 13.3 L
186 12.6 Jo	218 7.6 L	212 6.4 Pt	S CRA	*223* 6.9 Oy	218 14.0 L
209 11.6 Jo	*222* 8.0 Pt	212 6.7 Ra	*185437a*	*224* 6.5 Ah	U DRA
209 11.6 L	*222* 7.7 Ko	213 5.8 Fd	136 11.9 Ht	V LYR	190967
218 10.9 L	*223* 7.9 Oy	214 6.5 Cy	163 11.5 Ht	190529a	140 12.5 Ch
222 10.0 Pt	*223* 7.7 Ra	215 5.7 L	166 11.4 Sl	140[13.3 Ch	171 11.6 L
236 9.5 Hu	*237* 8.2 O	217 7.0 Hu	186 11.5 Ht	189[12.3 Pt	177 11.3 Ch
237 9.7 O	RS DRA	218 6.0 Gy	187 11.9 Sl	*222*[12.3 Pt	185 10.8 L
	184074	218 6.0 Bc	190 11.8 Ht	RX SGR	189 10.3 Jo
	177 11.0 Ch	*220* 6.0 Mg		*190818*	190 10.2 Pt
		220 6.4 Ra		134 10.1 Ch	190 9.5 We

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U DRA	RY SGR	RT AQL	RT CYG	X AQL	Z CYG
190967	*191033*	193311	194048	194604	195849
192 10.6 Jo	224 11.4 Pt	136 11.5 Ch	**162 10.8** Jo	187 13.8 L	220 10.2 L
204 9.8 Jo	225 11.2 L	156 10.3 Ch	168 11.0 Jo	190 13.5 Pt	222 10.9 Pt
209 9.6 Jo	S SGR	166 8.5 L	177 11.7 Ah	208 12.4 L	S TEL
209 9.5 L	*191319a*	186 7.4 L	182 11.5 Jo	220 11.8 L	*195855*
212 9.8 We	134 11.0 Ch	190 7.9 Pt	185 11.8 Jo	222 11.9 Pt	136[12.6 Ht
218 9.2 L	136 11.0 Ht	208 7.7 L	187 12.0 Jo	χ CYG	190[12.6 Ht
222 9.0 Pt	186 13.9 L	214 8.6 Ah	189 12.5 Jo	194632	SY AQL
236 9.8 Hu	190 13.1 Pt	218 7.9 L	190 11.9 Pt	138 9.7 Ch	200212
W AQL	213[14.4 L	222 8.2 Pt	192 12.5 Jo	156 10.7 Ch	187 14.3 L
191007	222[12.2 Pt	224 9.0 Ah	197 12.6 Jo	185 12.2 Cy	213 14.5 L
140[12.6 Ch	Z SGR	R CYG	204 12.3 Jo	190 12.2 Pt	221 14.6 L
186 14.0 L	*191321*	193449	207 12.0 Jo	193 12.2 Ch	S CYG
210 13.6 L	186 14.0 L	138 9.0 Ch	209 12.0 Jo	210[12.0 Gy	200357
220 13.6 L	213 14.2 L	162 10.3 Jo	213 12.5 Fd	222 13.0 Pt	139[13.3 Ch
222 13.2 Pt	223 14.3 L	168 10.2 Jo	222 11.5 Pt	234[12.4 Gy	190[12.4 Pt
T SGR	TZ CYG	177 10.9 Ah	225 11.1 Gy	S PAV	222 13.0 Pt
191017	191350	182 10.5 Jo	233 9.5 Hf	*194659*	R CAP
134 8.2 Ch	190 10.0 Pt	183 11.3 Gy	234 9.5 Hf	166 8.4 Sl	*200514*
169 8.3 Ch	222 10.5 Pt	184 11.1 Ko	234 9.9 Gy	RU SGR	187 13.8 L
190 8.9 Pt	U LYR	185 10.5 We	236 10.0 Hu	*195142*	190 12.7 Pt
222 9.7 Pt	191637	185 10.8 Jo	TU CYG	136 13.2 Ht	213 13.7 L
236 10.3 Hu	162 10.5 Jo	187 11.1 Jo	194348	190 11.5 Ht	223 13.9 L
R SGR	168 11.0 Jo	189 11.5 Ah	156 10.4 Ch	RR AQL	S AQL
191019	182 11.0 Jo	189 11.0 Jo	162 9.8 Jo	*195202*	200715a
168 10.9 L	185 10.8 Jo	190 10.8 Pt	167 9.5 L	167 8.6 L	182 9.6 Jo
179 9.8 L	190 10.7 Pt	192 11.3 Jo	171 9.4 Ry	186 9.5 L	192 11.2 Jo
184 9.4 Ko	192 11.0 Jo	194 11.4 Ch	176 9.3 Ry	208 10.4 L	204 11.3 Jo
190 9.2 Pt	197 11.4 Jo	197 11.4 Jo	180 9.2 Ry	220 10.7 L	209 11.5 Jo
190 8.7 Ht	209 11.7 Jo	204 11.7 Jo	182 9.0 Jo	RS AQL	222 11.6 Pt
207 8.4 L	213 12.6 Fd	207 11.9 Jo	185 9.0 Jo	*195308*	RW AQL
220 8.1 L	222 11.8 Pt	209 12.2 Jo	185 9.1 Ry	167[14.0 L	200715b
222 8.1 Pt	AF CYG	213 12.3 Fd	186 9.2 L	187[13.8 L	182 9.5 Jo
236 7.7 Hu	192745	222 12.1 Pt	189 9.0 Jo	220[13.0 L	192 9.7 Jo
RY SGR	177 7.3 Ah	225 12.6 Gy	189 9.1 Ry	NOV CYG	204 9.7 Jo
191033	188 7.3 Ah	234[12.3 Gy	190 9.1 Pt	195553	209 9.8 Jo
134 9.0 Ch	189 7.3 Ah	RV AQL	192 8.8 Jo	156[12.9 Ch	222 9.3 Pt
136 9.0 Ht	191 7.2 Ah	193509	193 9.2 Ry	189[12.2 Pt	RU AQL
163 9.4 Ht	195 6.9 Ah	167 12.2 L	194 9.0 Ch	222[12.2 Pt	200812
164 9.4 L	197 7.0 Se	186 13.3 L	197 8.9 Jo	RR TEL	187 13.9 L
165 10.2 Ch	214 6.9 Ah	190 13.5 Pt	198 9.4 Ry	*195656*	213 14.3 L
166 9.3 L	217 6.6 Ah	210 13.8 L	204 9.0 Jo	136[12.6 Ht	221 14.3 L
166 10.2 Sl	218 6.9 Se	220 13.6 L	205 9.4 Ry	190[12.6 Ht	W CAP
167 9.4 L	221 6.9 Se	T PAV	207 9.1 Jo	Z CYG	*200822*
168 9.3 L	224 6.5 Ah	*193972*	208 9.5 Ry	195849	213 11.6 L
185 11.0 L	TY CYG	136 13.3 Ht	209 9.1 L	134 8.4 Ch	222 11.8 Pt
186 11.2 L	192928	153 13.3 Bl	209 9.4 Jo	156 7.5 Ch	223 11.4 L
186 11.3 Ht	134 10.6 Ch	159 12.7 Bl	212 9.4 Ry	171 7.6 L	Z AQL
187 11.0 Bl	140 10.3 Ch	163 11.9 Ht	214 9.6 Ry	180 7.9 L	*200906*
190 11.4 Ht	156 9.6 Ch	166 12.3 Sl	216 9.6 Ry	185 8.4 Jo	171 9.2 Bm
190 11.5 Pt	169 9.5 Ch	174 11.7 Bl	217 9.6 Ry	187 8.3 Jo	185 9.8 Bm
193 10.6 Ch	171 9.6 L	183 10.5 Ht	218 9.4 L	189 8.5 Jo	222 12.6 Pt
208 10.6 L	186 10.2 L	188 9.9 Bl	222 9.6 Pt	190 8.3 Pt	R SGE
213 11.0 L	190 10.3 Pt	190 9.5 Ht	223 9.7 Ry	192 8.4 Jo	200916
215 11.0 L	208 11.5 L	193 8.9 Bl	236 10.7 Hu	197 8.5 Jo	182 9.2 Jo
220 11.2 L	218 11.7 L	RT CYG		204 9.0 Jo	192 9.0 Jo
222 11.5 Pt	222 11.8 Pt	194048		207 9.3 Jo	204 9.0 Jo
223 11.5 Pt		138 8.5 Ch		209 9.9 Jo	209 9.0 Jo
223 11.0 L		156 9.7 Ch		209 9.3 L	

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RS CYG	WX CYG	RU CAP	V AQR	TW CYG	T CEP
200938	201437b	*202622*	204102	210129	210868
136 7.3 Ch	197 12.2 Jo	185 13.8 Bm	167 8.5 L	187 11.0 L	189 6.9 Jo
139 7.2 Ch	204 12.0 Jo	Z DEL	187 8.9 L	209 9.8 L	189 6.9 Se
156 7.2 Ch	208 11.7 L	202817	209 9.0 L	218 10.0 L	191 7.6 Ah
162 7.3 Jo	209 12.1 Jo	167 10.4 L	220 8.9 L	X CAP	192 7.2 Ra
165 7.2 Ch	218 11.7 L	187 11.5 L	222 8.4 Pt	*210221*	192 6.8 Jo
168 7.2 Jo	222 11.2 Pt	209 13.1 L	W AQR	209 11.4 L	195 7.8 Ah
169 7.2 Ch	V SGE	220 13.3 L	*204104*	220 11.5 L	197 7.2 Jo
171 7.4 L	201520	ST CYG	171 13.0 Bm	223 12.2 Pt	203 8.2 Hf
180 7.3 Cy	192 10.6 Jo	202954	185 13.2 Bm	X CEP	204 7.6 Jo
182 7.2 Jo	U CYG	136 13.1 Ht	187 13.2 L	210382	207 7.7 Jo
184 7.4 Ko	201647	167 10.1 L	209 12.0 L	177 10.1 Ch	209 7.7 Jo
185 7.2 Jo	139 8.0 Ch	187 11.1 L	220 11.7 L	183 9.0 Ch	209 8.2 Oy
186 7.4 Cy	162 8.1 Jo	209 11.9 L	U CAP	187 8.9 L	210 7.3 Se
187 7.3 L	168 8.0 Jo	218 12.6 L	*204215*	209 8.7 L	210 8.2 Hf
189 7.3 Jo	177 8.0 Ah	222 12.3 Pt	167 11.3 L	218 8.9 L	211 7.4 Se
191 7.7 Cy	182 7.9 Jo	V VUL	209 12.0 L	RS AQR	212 8.8 We
192 7.2 Jo	184 8.2 Ko	203226	220 12.5 L	*210504*	212 8.2 Ah
192 7.5 Ra	185 8.6 Hf	222 8.8 Pt	V DEL	168 10.6 L	214 8.0 Sq
197 7.2 Jo	185 8.0 Jo	Y DEL	204318	185 10.9 L	217 8.6 Ah
203 7.9 Hf	189 7.9 Ah	203611	187[13.0 L	209 11.9 L	220 8.3 Ra
204 7.3 Jo	189 7.8 Jo	164 12.7 L	210 13.9 L	220 12.2 L	223 8.1 Pt
208 7.3 L	190 7.1 Se	185 11.3 L	220 13.9 L	223 12.8 Pt	223 8.4 Oy
209 7.3 Jo	192 7.5 Ra	207 11.0 L	T AQR	Z CAP	224 8.8 Ah
210 7.4 Ra	192 7.7 Jo	215 11.0 L	*204405*	*210516*	226 9.0 Hf
210 8.0 Hf	194 7.7 Ch	215 10.9 Ma	165[11.0 Ch	171 10.6 Bm	232 8.8 O
218 7.4 L	195 7.9 Ah	223 11.3 L	191 8.8 Cy	185 11.4 Bm	234 8.6 Hf
222 7.2 Pt	197 7.7 Jo	S DEL	*222* 8.0 Pt	223 12.7 L	RR AQR
222 7.4 Ko	197 6.9 Se	203816	RZ CYG	223 13.0 Pt	*210903*
233 7.9 Hf	203 7.9 Hf	182 12.0 Jo	204846	R EQU	171 10.9 L
234 7.5 O	204 7.6 Jo	*222* 9.7 Pt	*222* 12.5 Pt	210812	213 13.9 L
R DEL	204 7.7 Ah	V CYG	S IND	171 14.4 Bm	223[13.9 L
201008	206 7.5 Mc	203847	*204954*	185 14.0 Bm	Y PAV
171 11.3 L	207 7.6 Mc	139 9.9 Ch	190[13.1 Ht	187 13.8 L	*211570*
184 9.9 Ko	207 7.6 Jo	162 10.5 Jo	X DEL	210 14.0 L	136 6.5 Ht
187 10.4 L	208 7.6 Ra	167 9.8 L	205017	220 13.9 L	190 6.5 Ht
191 9.7 Cy	209 7.5 Jo	185 10.3 Jo	167 9.8 L	T CEP	X PEG
209 8.2 L	210 7.6 Hf	187 10.8 L	187 9.6 L	210868	211614
220 8.2 L	211 7.9 Ad	189 10.3 Jo	209 10.0 L	139 6.0 Ch	164 9.9 L
221 7.6 We	212 7.6 Ah	192 10.5 Jo	220 10.1 L	162 6.5 Jo	185 9.8 L
222 8.4 Pt	213 7.5 Fd	194 10.8 Ch	223 9.9 Pt	164 6.4 Ch	209 10.7 L
SX CYG	213 7.5 Mc	204 11.0 Jo	R VUL	168 6.5 Jo	215 11.2 Ma
201130	215 7.5 Ra	209 11.3 Jo	205923a	168 6.5 Ah	220 11.9 L
185 10.1 Cy	217 7.7 GD	209 11.2 L	182 10.0 Jo	169 6.8 Ch	223 11.5 Pt
222 8.0 Pt	217 7.5 Ah	215 11.4 Ma	185 10.3 Jo	176 8.4 We	T CAP
WX CYG	218 6.6 Se	218 11.6 L	187 10.6 Jo	177 6.7 Ah	*211615*
201437b	219 8.2 We	222 11.6 Pt	189 11.2 Jo	177 7.6 Th	168 9.5 L
139 12.2 Ch	221 6.7 Se	Y AQR	192 11.7 Jo	180 7.1 Ra	209 11.1 L
156 12.8 Ch	*222* 7.0 Pt	*203005*	204 12.0 Jo	182 6.9 Jo	220 12.3 L
162 12.5 Jo	222 7.0 Ko	171 13.8 Bm	209 12.5 Jo	183 7.8 Th	Y CAP
168 12.6 Jo	225 7.7 GD	185 14.0 Bm	V CAP	185 7.6 Jo	*212814*
171 12.3 L	*226* 7.6 Hf	*222*[12.3 Pt	*210124*	185 6.9 Ko	209[11.0 L
180 12.0 Cy	227 7.7 GD	T DEL	215 12.5 L	185 6.9 Se	223[13.1 L
182 12.5 Jo	232 7.3 Hf	204016	223 13.2 L	185 7.5 Oy	W CYG
185 12.4 Jo	232 7.0 Sh	187 14.2 L	TW CYG	186 6.9 Se	213244
187 12.1 L	239 7.5 Sf	213 14.7 L	210129	187 7.8 Jo	187 6.6 L
189 12.6 Jo	RU CAP	222[12.9 Pt	171 11.3 Bm	188 7.5 Ah	206 6.5 Mc
191 12.0 Cy	*202622*		171 11.8 L	189 7.5 Ah	207 6.4 Mc
192 12.5 Jo	171 13.0 Bm		185 10.6 Bm	189 7.9 Th	207 6.8 L

Variable Star Observations Received During May and June, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
W Cyg	RU Cyg	V Peg	RV Peg	V Cas	R Aqr
213244	213753	215605	222129	230759	*233815*
211 6.5 An	182 8.4 Jo	213 12.8 L	117 13.2 L	146 8.8 Ch	187 7.9 Sl
213 6.5 An	182 8.1 Ry	221 12.4 L	167 9.6 L	168 8.2 Ah	194 8.0 Ch
213 6.6 Mc	185 8.1 Ry	223 12.2 Pt	207 9.8 L	177 8.3 Ah	Z Cas
215 6.5 An	185 8.4 Jo	U Aqr	220 10.1 L	185 8.4 Cy	233956
220 6.7 L	189 8.1 Ry	*215717*	S Lac	188 8.4 Ah	187 14.0 L
S Cep	189 8.4 Jo	223 12.2 Pt	222439	189 8.4 Ah	220 14.2 L
213678	189 8.3 Ah	223 12.5 L	171 12.6 L	192 8.3 Cy	R Tuc
162 7.7 Jo	190 8.0 Cy	RT Peg	213 12.6 L	214 9.6 Ah	*235265*
168 7.8 Jo	191 8.2 Ah	215934	221 12.3 L	217 9.7 Ah	137 12.2 Ht
177 8.9 Th	192 8.3 Jo	189[13.0 Ma	223 12.0 Pt	221 8.6 We	148 11.6 Ht
182 8.0 Jo	193 8.0 Ry	215[13.0 Ma	R Ind	223 10.5 Pt	R Cas
183 8.8 Th	195 8.1 Ry	RZ Peg	*222867*	W Peg	235350
183 8.4 Ch	198 8.1 Ry	220133b	136 11.7 Ht	231425	193 11.4 Ch
185 7.9 Jo	205 8.1 Ry	187 12.9 L	139 12.0 Bl	171 8.0 L	217 7.7 Ah
185 8.8 Cy	207 8.3 Jo	213 12.7 L	152 13.0 Bl	207 8.9 L	224 7.5 Ah
189 8.9 Th	207 9.1 Mc	221 12.6 L	190[12.0 Ht	220 9.4 L	226 7.3 Hf
189 8.0 Jo	208 8.1 Ry	T Peg	T Tuc	S Peg	234 7.3 Hf
192 7.9 Jo	209 8.2 Jo	220412	*223462*	231508	Z Peg
192 8.9 Cy	212 8.1 Ry	166 9.5 L	190 8.5 Ht	220 12.5 L	235525
197 7.7 Jo	214 8.2 Ry	185 8.7 L	R Lac	Z And	213 12.1 L
204 7.9 Jo	217 8.4 Ah	208 8.8 L	223841	232848	223 12.2 L
207 8.0 Jo	223 8.1 Pt	220 9.4 L	171 10.6 L	185 10.4 Cy	223 12.4 Pt
209 8.1 Jo	234 8.5 O	225 9.9 Gy	207 12.6 L	189 10.7 Ma	225 12.1 Gy
209 9.0 Je	RV Cyg	Y Peg	220 13.6 L	191 10.3 Cy	Y Cas
211 8.6 Ad	213937	220613	RW Peg	215 10.8 Ma	235855
214 8.8 Sq	223 6.4 Pt	171[11.6 Bm	225914	223 10.6 Pt	162 10.6 Jo
219 8.0 We	RR Peg	223[12.5 Pt	171 10.8 L	ST And	187 10.9 L
220 9.2 Je	214024	RS Peg	189 12.3 Ma	233335	213 10.1 L
223 8.2 Pt	189 13.9 Ma	220714	213 13.4 L	189 9.2 Jo	223 10.3 L
RU Cyg	223 13.0 Pt	187 14.0 L	223 13.6 L	191 9.2 Cy	SV And
213753	R Gru	213 14.0 L	223 13.5 Pt	192 9.3 Jo	235939
176 8.0 Ry	*214247*	221 14.2 L	R Peg	209 9.3 Jo	189[13.8 Ma
177 8.2 Ah	190[12.4 Ht	S Gru	230110	223 9.8 Pt	223[12.3 Pt
181 9.3 Je		*221948*	223 10.3 Pt		
		190[12.2 Ht			

Rapidly Varying Irregular Variables.

Star J.D. Est.Obs.	J.D. Est.Obs.	Star J.D. Est.Obs.	J.D. Est.Obs.
005840 RX Andromedae—		060547 SS Aurigae—	
7166.3[11.3 Ry	7222.8 11.8 Pt	7181.4 11.8 Ry	7185.6 12.8 B
7190.9 11.5 Pt	7223.5 11.6 Ry	7181.6 11.2 Mg	7185.6 12.8 Ko
7195.6 12.1 Ry	7223.9 11.7 Pt	7181.7 11.5 Hi	7185.7 12.4 Hi
7210.6 11.9 Ry	7224.5 11.5 Ry	7181.7 11.5 Pt	7186.3 13.2 L
7212.5 11.8 Ry	7224.9 11.5 Pt	7182.1 11.3 Ch	7186.6 12.9 Bw
7213.6 11.8 Ry	7225.8 11.3 Gy	7182.4 11.3 Ry	7186.8 12.8 Br
7216.5 11.7 Ry		7182.6 11.3 B	7186.8 13.3 Pt
060547 SS Aurigae—		7182.7 11.3 Hi	7187.3 13.6 L
7150.1[13.0 Ch	7173.7[12.5 Hi	7182.8 11.3 Br	7188.6 14.4 Lg
7154.2 11.6 Ch	7174.3[13.9 L	7183.7 11.6 Gy	7189.1 11.7 Ch
7157.1 11.6 Ch	7176.4[13.9 Ry	7183.7 11.3 Hi	7190.6 13.4 Bw
7162.1[13.0 Ch	7177.1 14.8 Bm	7183.7 11.6 Pt	7193.5[13.2 Ry
7164.5[12.5 Ry	7178.1 14.7 Bm	7184.6 12.5 Cy	7195.5[11.5 Ry
7166.1[13.9 Bm	7179.3 14.5 L	7184.7 11.9 Hi	7196.7[12.5 Hi
7167.3[13.9 L	7180.4 14.2 Ry	7184.7 12.3 Pt	7197.6[13.4 Bw
7170.3[13.3 L	7180.6 13.9 B	7185.4 12.3 Ry	7201.7[12.4 Hi
7171.3[12.5 Ry	7180.7 13.5 Hi	7185.6 12.5 Gy	7205.7[12.5 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
060547 SS AURIGAE—						
	7207.4	12.5	L	7215.7	11.8	Pt
	7208.4	13.9	L	7216.3	11.1	L
	7209.4	13.9	L	7217.3	11.1	L
	7210.6	12.5	Cy	7217.7	11.7	Hi
	7211.6	12.5	Cy	7218.4	11.4	L
	7212.7	13.0	Hi	7218.7	12.0	Hi
	7213.3	12.5	L	7223.4	12.5	L
	7214.4	12.5	Ry	7224.4	12.5	Ry
	7215.4	12.5	L	7225.7	11.0	Pt
	7215.6	11.3	Cy	7233.7	11.0	Pt
074922 U GEMINORUM—						
	7133.0	13.3	Sl	7186.3	14.1	L
	7149.2	11.4	Ch	7187.4	14.2	L
	7150.2	12.4	Ch	7189.1	14.1	Ch
	7152.2	13.7	Ch	7189.7	12.4	Pt
	7154.7	14.0	Br	7188.8	13.2	Br
	7159.0	13.3	Sl	7190.6	13.8	Bw
	7160.4	13.8	So	7191.6	12.4	Cy
	7166.1	13.3	Bm	7197.6	13.3	Bw
	7167.3	12.9	L	7205.7	10.9	Pt
	7170.1	13.3	Bm	7208.4	13.3	L
	7174.3	13.8	L	7209.4	14.0	L
	7177.0	13.3	Sl	7210.6	12.4	Cy
	7178.1	14.1	Bm	7211.6	12.4	Cy
	7179.3	14.1	L	7212.7	11.2	Pt
	7180.6	13.9	B	7213.4	13.8	L
	7181.7	12.4	Pt	7214.4	13.8	L
	7182.1	13.8	Ch	7215.7	13.3	Pt
	7183.9	13.3	Sl	7217.4	12.4	L
	7184.7	12.4	Pt	7218.4	13.0	L
	7185.6	14.1	B			
081473 Z CAMELOPARDALIS—						
	7152.2	10.9	Ch	7182.8	11.6	Br
	7154.7	11.2	Br	7183.7	12.1	Cy
	7155.2	10.5	Ch	7183.7	12.0	Pt
	7164.5	12.2	Ry	7184.6	12.4	Ko
	7164.7	12.0	L	7184.7	12.2	Pt
	7166.4	12.4	Ry	7185.4	12.7	Ry
	7166.6	12.1	L	7185.6	12.4	Cy
	7167.3	12.2	L	7185.6	12.4	Ko
	7168.3	12.3	L	7185.6	12.8	L
	7168.6	13.1	L	7185.8	12.0	Pt
	7170.3	12.4	L	7186.3	12.6	L
	7171.3	12.8	Ry	7186.6	12.3	Ko
	7171.3	12.8	L	7186.6	12.5	Gy
	7173.3	13.1	L	7186.7	12.8	Br
	7174.3	13.0	L	7186.8	12.4	Pt
	7176.5	12.8	Ry	7187.4	12.8	L
	7177.4	11.5	Ry	7187.7	12.3	Pt
	7178.4	11.3	Ry	7188.8	13.0	Br
	7178.4	11.1	L	7189.5	12.9	Ry
	7179.3	11.1	L	7189.7	12.4	Pt
	7180.5	11.6	Ry	7189.7	12.6	Cy
	7180.7	11.3	Cy	7190.7	12.5	Pt
	7181.4	12.0	Ry	7190.8	12.6	Md
	7182.2	12.1	Ch	7193.5	13.2	Ry
	7182.5	12.1	Ry	7195.5	12.7	Ry
	7182.7	12.1	Md	7198.5	11.3	Ry
081473 Z CAMELOPARDALIS—						
	7207.3	11.4	L	7216.4	12.8	L
	7208.4	13.0	L	7216.8	12.7	Cy
	7208.4	12.8	Ry	7217.4	12.7	L
	7209.4	12.9	L	7218.4	12.7	L
	7209.7	12.6	Pt	7219.5	13.3	Ry
	7210.5	13.1	Ry	7220.6	12.9	L
	7210.7	12.6	Cy	7221.5	12.8	L
	7210.7	12.7	Pt	7222.8	10.7	Pt
	7212.5	13.3	Ry	7223.4	10.6	L
	7212.7	12.5	Pt	7223.5	10.7	Ry
	7213.4	12.5	L	7223.6	10.5	L
	7213.5	13.1	Ry	7223.9	10.8	Pt
	7214.4	12.8	Ry	7224.4	10.8	Ry
	7214.4	12.8	L	7234.9	10.9	Pt
	7215.4	12.9	L	7225.7	11.7	Pt
	7215.4	12.8	Ry	7225.8	11.1	Gy
	7215.7	12.9	Pt	7234.7	12.7	Pt
	7216.4	13.3	Ry			
094512 X LEONIS—						
	7181.7	12.6	Pt	7205.7	11.8	Pt
	7182.8	13.5	Br	7209.7	12.6	Pt
	7183.7	12.6	Pt	7210.7	12.5	Pt
	7184.7	12.6	Pt	7212.7	12.5	Pt
	7186.8	13.3	Br	7215.7	12.6	Pt
	7187.7	12.6	Pt	7225.6	12.4	B
	7189.7	12.6	Pt	7234.7	12.6	Pt
	7190.7	12.6	Pt			
202946 SZ CYGNI—						
	7183.7	9.0	Pt	7222.8	9.6	Pt
	7185.8	8.7	Pt	7223.9	9.6	Pt
	7186.8	9.0	Pt	7224.9	9.3	Pt
	7189.7	9.1	Pt	7225.7	9.4	Pt
	7190.7	9.5	Pt	7226.7	9.4	Pt
	7209.7	9.7	Pt	7231.7	8.7	Pt
	7210.7	9.8	Pt	7232.8	8.7	Pt
	7212.7	9.5	Pt	7233.7	9.1	Pt
	7215.7	8.6	Pt	7234.7	9.4	Pt
	7218.7	9.2	Pt			
213843 SS CYGNI—						
	7074.0	11.7	Ch	7184.7	12.1	Hu
	7090.1	11.8	Ch	7185.2	11.7	Hr
	7099.0	8.6	Ch	7185.6	11.8	L
	7102.0	8.6	Ch	7185.7	11.9	Jo
	7107.0	9.6	Ch	7185.8	11.7	Pt
	7130.5	12.1	Ch	7185.8	11.8	Cy
	7138.5	12.1	Ch	7186.6	11.8	L
	7156.4	12.1	Ch	7186.7	12.0	Jo
	7164.6	8.4	L	7186.8	11.9	Cv
	7166.4	8.3	Ch	7186.8	11.7	Pt
	7166.6	8.6	L	7187.6	11.8	L
	7167.7	8.9	L	7189.2	11.4	Hr
	7168.7	8.8	L	7189.4	11.8	Ah
	7171.6	9.4	L	7189.7	12.0	Jo
	7177.5	11.8	Ah	7189.8	11.9	Ma
	7179.6	11.4	L	7190.9	11.8	Pt
	7180.8	11.9	Cy	7190.9	11.9	Cy
	7182.8	12.0	Jo	7191.1	11.4	Hr
	7183.7	11.9	Jo	7191.4	11.8	Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING MAY AND JUNE, 1933.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—							213843 SS CYGNI—						
	7191.9	11.9	Cy	7212.4	11.8	Ah		7218.4	11.8	L	7230.6	8.3	Wa
	7192.7	11.7	Jo	7212.7	11.7	Pt		7220.6	11.9	L	7231.7	8.6	Pt
	7192.9	11.9	Cy	7213.4	11.7	L		7220.7	12.0	Mg	7232.6	8.3	O
	7194.4	11.4	Ch	7213.6	11.6	L		7221.6	11.5	L	7232.8	8.7	Pt
	7204.6	11.8	Jo	7213.7	11.7	Bh		7222.8	11.8	Pt	7233.7	8.9	Pt
	7206.7	12.0	Hu	7213.7	11.8	Mg		7223.4	11.3	L	7234.6	8.3	O
	7207.6	11.9	Jo	7213.8	11.6	Fd		7223.5	11.3	L	7234.6	8.4	Wa
	7207.6	11.6	L	7214.4	11.7	L		7223.9	11.7	Pt	7234.7	8.6	Hu
	7208.6	11.6	L	7215.4	11.7	L		7224.5	10.6	L	7234.7	9.0	Pt
	7209.6	11.6	L	7215.6	11.6	L		7224.5	11.2	Ah	7235.6	8.4	O
	7209.6	11.9	Jo	7215.7	11.9	Pt		7224.7	10.8	Mg	7235.7	8.3	Hf
	7210.6	11.6	L	7215.7	11.9	Ma		7224.9	10.4	Pt	7237.6	8.9	O
	7210.7	11.8	Pt	7217.5	11.8	Ah		7226.7	8.4	Pt	7238.7	8.7	Hu
	7211.9	11.7	Ma	7217.7	11.9	Hu		7230.6	8.3	O			

SUMMARY FOR MAY AND JUNE, 1933.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	42	178	Kanamori	Km	2	9
Aldwell	Ad	8	8	Kanda	Kd	2	2
Ancarani	An	11	16	Kohman	Ko	31	88
Baldwin	Bl	70	305	Lacchini	L	177	727
Ballhaussen	Ba	2	16	Logan	Lg	3	4
Bappu	Bm	30	54	Marsh	Ma	14	19
Benini	Be	14	20	McLeod	Mc	18	34
Beyer	BR	9	44	Millard	Md	9	10
Bigelow	Bw	27	60	Monnig	Mg	19	30
Bouton	B	74	90	O'Byrne	Oy	15	31
Brocchi	Br	19	26	Olcott	O	12	16
Brown, A. N.	Bn	3	9	Parthe	Pa	2	3
Buckstaff, E.F.	Bf	5	7	Peltier	Pt	213	472
Buckstaff, R.N.	Bc	7	25	Perkinson	Pk	7	9
Bunch	Bh	8	8	Raphael	Ra	20	48
Bunting	Bg	2	12	Rosebrugh	Rb	2	7
Chandra	Ch	181	424	de Roy	Ry	9	100
Cilley	Cy	63	144	Scanlon	Sc	12	24
Ensor	En	65	202	Schenkman	Se	9	60
Ford	Fd	9	9	Shinkfield	Sl	31	123
Friton	Fn	2	2	Shultz	Sz	12	20
Godfrey Club	GD	3	9	Smith, F. P.	Sq	15	40
Goodsell	Gs	6	6	Smith, F. W.	Sf	11	34
Gregory	Gy	33	70	Smith, L.	Sh	17	36
Hartmann	Hf	41	159	Theile	Th	7	15
Hess	He	6	12	Thew	Tw	3	3
Hildom, A.	Hi	12	33	Watson	Wa	5	6
Houghton	Ht	83	379	Wetherbee	We	48	72
Jansen	Je	11	36				
Jones	Jo	116	733	Totals		59	426	5255
Kaho	Ka	1	18				

cut, and Mr. Sterling Bunch of Knoxville, Tennessee. The report, although a double one, is almost a record breaker, certainly as regards the number of contributors thereto.

The Spring meeting held on May 20 at New London and Four Corners, Connecticut, was a huge success. Fifty members and guests were present and Connecticut College and Dr. Brown deserve more than passing comment for so delight-

fully entertaining us and providing for our comforts. The papers presented were interesting and illuminating and plenty of opportunity was available for discussion and good fellowship. A complete account of the meeting is to appear in the next number of Variable Comments, written by Miss Furness.

SS Cygni was at maximum on April 1 and again on June 1, the former being of the narrow, ripid-rising type, and the latter of the broad, rapid-rising type. SS Aurigae presented another narrow type maximum on May 22, making the ninth consecutive maximum of this type during the past year. RY Sagittarii is still faint, at the eleventh magnitude when last reported. R CrB, for nine years at maximum, still needs careful watching. Its drop to minimum must not escape us!

LEON CAMPBELL, Recorder.

July 5, 1933.

Comet Notes

By G. VAN BIESBROECK

There have not been any additions to the list of comets mentioned as visible in the last notes (p. 323). PERIODIC COMET 1925 II (SCHWASSMAN-WACHMANN) is now lost in the sun's rays after several months of extraordinary fluctuations in shape as well as in brightness. We have to wait until late autumn to see it again.

The three comets now remaining under observation are faint and have passed their maximum brightness. COMET 1932*g* (GEDDES) is still visible in the evening sky. It moves slowly across the constellation of Canes Venatici, which it will occupy to the end of the year. This object has been under continuous observation for more than a year from the time of discovery 1932 June 22. Besides, Dr. Whipple announced recently that he had found a faint image of this object on a plate exposed Aug. 14, 1931, at the Southern Station of the Harvard Observatory at Bloemfontein (South Africa); the magnitude given for that date was 13th. This is thirteen months before the time of perihelion passage (1932 Sept. 21); therefore we can expect that the object will remain observable for several months more. When last seen here (July 10) the comet had dropped to magnitude 13. There was still a well-defined condensation in the round coma but the tail was no longer visible in the 40-inch telescope. The following ephemeris (*British Astronomical Handbook*, 1933) shows the course until the end of the year.

EPHEMERIS OF COMET 1932*g* (GEDDES).

1933 0^h U.T.		α h m s	δ ° ′	Distance from Sun	Distance from Earth
Aug.	3	12 17 19	+35 52	4.07	4.67
	11	20 46	35 34	4.14	4.80
	19	24 46	35 19	4.20	4.91
	27	29 11	35 07	4.27	5.01
Sept.	4	33 48	34 59	4.33	5.10
	12	38 57	34 56	4.40	5.17
	20	44 12	34 58	4.46	5.23
	28	49 35	35 05	4.52	5.27
Oct.	6	12 55 07	+35 19	4.59	5.30

In the morning sky two faint periodic comets will remain visible for some time: PERIODIC COMET 1933*c* (GIACOBINI-ZINNER) follows closely the path indicated by the ephemeris (p. 324) which is continued here (*Circular 439* of Copenhagen):

EPHEMERIS OF PERIODIC COMET (GIACOBINI-ZINNER).

1933 0^h U.T.	α h m s	δ ° ′	Distance from Earth	Distance from Sun
July 27	4 47 6	+19 35	1.27	1.01
Aug. 4	5 20 0	16 26		
12	5 50 6	13 8	1.33	1.07
20	6 17 30	9 48		
28	6 42 24	6 30	1.41	1.17
Sept. 5	7 4 54	3 15		
13	7 25 6	+ 0 5	1.47	1.30
21	7 43 0	— 2 58		
29	7 58 54	5 54	1.53	1.44
Oct. 7	8 12 54	8 43		
15	8 24 48	11 26	1.57	1.58
23	8 34 30	—14 3		

On July 3 it appeared as a well-defined coma of magnitude 11 with a short tail pointing away from the sun. The brightness will begin to decrease in August but there will be a compensation through better conditions of visibility.

PERIODIC COMET 1933*b* (PONS-WINNECKE) is now difficult to observe from northern latitudes. When last seen here July 3 just before dawn it appeared as a rather large and very diffuse round coma roughly of magnitude 12. It is much better placed for observers south of the equator, who will probably follow it for several months longer.

The expected PERIODIC COMET FINLAY has not yet been recovered. The search made this spring in the Southern hemisphere did not reveal its presence near the computed position. The comet should now be best placed for northern observers but its angular separation from the sun remains small so that the short time before daylight gives the only opportunity to look for it near the horizon. The position improves in August but the brightness will be decreasing by that time. The search ephemeris given by P. J. Harris and M. Sumner in the *Handbook of the British Astronomical Association* for 1933 may require an appreciable correction. The columns $\Delta\alpha$, $\Delta\delta$ show the correction to be applied to the coördinates for a perihelion one day later than the assumed date, June 20.0.

1933 0^h U.T.	α h m s	δ ° ′	$\Delta\alpha$ m	$\Delta\delta$ ′
July 30	5 33 30	23 28	—1.77	—3.4
Aug. 7	6 1 6	23 54	1.62	2.0
15	6 27 0	24 3	1.48	—0.8
23	6 51 0	23 57	1.35	+0.1
31	7 13 12	23 40	1.22	0.7
Sept. 8	7 33 36	23 15	1.11	1.3
16	7 52 12	22 45	1.01	1.7
24	8 9 0	22 12	—0.94	+2.0

Williams Bay, Wis. July 10, 1933.

New Comet.—A cablegram received on July 17 from Professor Strömgren announces the discovery by Carrasco of a comet in the following position: 1933 July 15.8889, R.A. $13^h\,10^m\,24^s$; Dec. —12° 43′. Magnitude 10. Motion West 1^m 32^s, North 56′.

HARLOW SHAPLEY.

Harvard College Observatory Announcement Card 271, July 17, 1933.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

For several years past, some of the most active and industrious observers in the American Meteor Society have been in the Texas Group. Not only have they made the usual observations and reported them individually, but their leaders have interested others, and on several occasions simultaneous work for parallax has been undertaken at two or three stations. During the year 1928 such work was carried out on April 21-22, 23-24, August 10-11, 11-12, October 20-21, and November 10-11. The data were promptly sent to headquarters, but due to press of other work they were temporarily laid aside. Recently, however, the results have been worked out by Mrs. D. M. Wills, under the general supervision of the writer. Other members of the staff have assisted in checking the computations.

The observations were planned under the supervision of Sterling Bunch (B) and O. E. Monnig (M), the former at present our regional director in Kentucky-Tennessee, the latter regional director in Texas. They were assisted by James H. Logan (L), D. C. Bubar (D), Robert Brown (R), Blakeney Sanders (S), and J. T. Chesley (C). The stations at various times were (1) Ft. Worth, (2) Dallas, (3) Decatur, (4) Hamilton, (5) Burleson, and (6) Springtown. The maximum number of stations occupied on any one night was three; the maximum number of observers on any single object was four. Regular A.M.S. recording maps and blanks were used, and careful plans were made so that each party observed in the proper direction to see objects visible from the coöperating stations.

The longitudes and latitudes of the stations are respectively:

	Longitude	Latitude	
(1)	97° 19.8	32° 47.9	a. April only
	97 21.2	32 47.9	b. Aug., Oct., Nov.
(2)	96 48.3	32 48.3	
(3)	97 32.1	33 13.6	
(4)	97 54.2	31 41.8	
(5)	97 16.7	32 33.8	
(6)	97 43.4	32 55.3	

The approximate lengths of the base lines used are therefore:

Stations		Distance		
1 - 2	(April)	49 km	(Aug.)	51 km
1 - 3	(April)	51	(Aug.)	50
1 - 4		133		
2 - 3		82		
2 - 4		160		
2 - 5		52		
2 - 6		86		
5 - 6		57		

The method used for these computations was the first one outlined by the writer in "Supplement to the Pilot Chart of the North Atlantic Ocean for 1931." published by the Hydrographic Office, U.S.N. It is found more expeditious than Schaeberle's Method, and gives better results when the data themselves are not extremely accurate. It should be added that the observations in 1928 represent the first attempt at duplicate observations for parallax by the Texas Group.

The accompanying table gives heights for 43 meteors (101 observations), the columns in order giving serial number of meteor, date, time to nearest minute (although seconds were and must be reported for observations made for heights),

mean beginning height with average deviation from the mean, end height with deviation, class of meteor, and station numbers with observers' initials.

Meteor No.	1928	Time C.S.T.	Mag.	Beginning km		End km		Class	Observers
1	April 21	12:55	3	25.1±	7.9	21.4±	6.1	Lyrid	1B, 3M, 3D
2	April 23	14:11	1	122.5	16.4	42.8	5.9	Lyrid	1M, 1B, 2L
3		14:58	3			183.3	5.0	Lyrid	1B, 2L
4	Aug. 10	12:18	1	134.3	*	96.6	4.2	Perseid	1M, 2L
5		12:33	2+	85.9	7.4	82.1	11.2	Perseid	1B, 2L
6		13:25	2+	62.1	6.3	47.6	4.6	Perseid	1M, 2L
7		13:29	3	110.3	3.5	73.0	5.3	Perseid	1B, 1M, 2L
8		13:36	2	172.6	3.7	140.0	2.6	Perseid	1B, 1M, 2L
9		13:39	1+	184.8	2.0	75.1	5.5	Perseid	1M, 2L
10	Aug. 11	11:34	2	78.2	8.3	62.5	5.3	Sporadic	1B, 2L, 3M
11		11:39	3+	131.7	2.0	104.4	5.0	Perseid	2L, 3M
12		11:46	4	109.9	2.2	77.8	6.1	Perseid	2L, 3M
13		11:47	1	104.4	9.2	87.8	11.1	Sporadic	2L, 3D
14		11:52	1			107.7	12.2	Perseid	2L, 3D
15		12:03	4	107.5	3.5	80.4	2.0	Perseid	2L, 3M
16		12:06	2+	131.3	14.8	76.7	17.0	Perseid	2L, 3M
17		12:18	3	102.9	6.3	90.7	3.5	Perseid	1B, 3M
18		12:19	—1	119.0	21.2	91.1	24.0	Perseid	1B, 2L, 3D
19		12:25	1			95.2	2.4	Perseid	2L, 3M
20		12:34	1	84.3	0.9	74.9	4.2	Perseid	2L, 3M
21		13:10	—1	124.3	9.4	80.8	0.2	Sporadic	1B, 3M
22		13:20	1+	108.4	27.7	84.8	*	Perseid	2L, 3D
23		13:25	2	301.5	4.6	101.4	3.0	Perseid	2L, 3D, 3M
24		13:35	2	136.8	9.8	116.0	18.8	Perseid	2L, 3M
25		13:42	2	110.1	1.7	56.8	6.5	Perseid	2L, 3M, 3D
26		14:03	2	121.3	2.0	111.8	0.6	Perseid	2L, 3D
27		14:35	2	67.5	*	49.8	10.0	Perseid	1R, 3M
28		15:06	2	130.8	10.7	93.7	*	Perseid	1B, 3M
29	Oct. 20	12:10	2	107.7	3.7	75.6	5.0	Sporadic	1B, 2M
30		12:23	1	116.2	2.6	80.8	12.2	Orionid	1B, 2M
31		12:40	3+	126.9	3.5	83.4	3.5	Sporadic	1B, 2M
32		12:36	3—	132.4	19.5	103.3	18.8	Orionid	1B, 2M, 4C
33		13:23	2	121.3	12.7	89.3	14.6	Spor.	1R, 2L, 2M, 4C
34		14:46	1+	195.5	25.3			Orionid	1S, 2L
35	Nov. 10	12:13	1+	105.5	10.0	84.6	7.7	Spor.	2L, 5M, 5R, 6S
36		12:50	0	129.3	10.7	90.4	14.2	Sporadic	2L, 6B
37		13:12	1+	135.4	5.3	143.7	31.4	Leonid	5M, 6S
38		13:21	1	105.9	24.7	74.5	13.8	Leonid	2L, 5M, 6B, 6S
39		14:36	2+			104.0	1.1	Sporadic	2L, 6B
40		15:08	2	68.1	0.4	49.8	13.6	Leonid	2L, 6B
41		15:46	2			69.7	5.7	Sporadic	5M, 6S
42		16:28	1	156.8	22.3	76.3	7.6	Sporadic	5M, 6S
43		16:51	0	129.3	42.0	61.4	4.4	Sporadic	5M, 6B

*Graphical solution; no mean deviation found.

MEAN HEIGHTS.

3 Lyrids	(2)	.....	(3)	....
22 Perseids	(20)	125.7	(22)	86.0
3 Orionids	(3)	148.0	(2)	83.0
3 Leonids	(3)	103.1	(3)	89.3
12 Sporadic Meteors	(10)	118.4	(12)	80.5

As there were only three each of the Lyrids, Orionids, and Leonids, the averages for these cannot mean very much; a single discordant value would utterly spoil any given average. But for the 22 Perseids and 12 sporadic meteors, we

have enough heights to feel some confidence in the mean values given. They agree reasonably well also with similar results published elsewhere, and are a real contribution to our knowledge. (Compare values given in *Meteors*, pp. 132-137.)

To indicate that the method here used for computing heights is better for many cases than Schaeberle's Method, certain comparative results have been found. For two meteors, observed by the Texas Group on 1929 July 27, Schaeberle's Method was tried. Meteor A, at 11:07, magnitude +1.5, was observed at two stations. No beginning height could be obtained; the end height was 65.7± 0.6 km. Meteor B, at 11:31, magnitude —0.5, was observed at three stations. No concordant solution could be found for either end of its path using data from all three stations. With the present method, however, we get:

Meteor	Beginning (km)	End (km)
A	140.7±33.9	68.6±1.5
B	133.0± 0.7	71.7±5.2

While the beginning point of A is certainly very poor, the end comes out in good agreement with the longer method. Excellent results are obtained for B, which formerly could not be satisfactorily solved.

Such simultaneous observations have a very real value, for the number of fairly reliable meteor heights derived to date is not large. There are few problems in which two or more amateurs, observing from 40 to 100 miles apart, could do better service than in the derivation of the heights of meteors. Also the longer they keep at it, the more valuable their observations become, as increased accuracy comes with practice. The Texas Group deserves great commendation for the observations on which these results depend. They were secured only by carefully coördinated efforts, and hard work on the nights when the meteors were actually seen.

Flower Observatory, Upper Darby, Pennsylvania, 1933 June 22.

The Temperature of the Mazapil Meteorite

By C. C. WYLIE

It is generally agreed that stone meteorites when recovered immediately after their fall are cold to milk warm in temperature. There are two probably authentic instances of frost having been found on the meteorites immediately after their recovery. In other instances, the meteorites were noticeably cold, and in several the temperature was not appreciably different from that of surrounding rocks lying in the sunshine. Careful investigation has brought to light no real proof that a stone meteorite has been uncomfortably hot at the time of recovery. Iron is a better conductor of heat, however, and the iron meteorites appear to be hotter. Few irons have, however, been observed to fall, and even for those which have been observed, the information is meager. The Mazapil meteorite is the standard illustration of a meteorite found while hot, and so we have thought it worthwhile to examine carefully the accounts as given in the letter of the ranchman on whose property it fell on November 27, 1885. We have copied this from Hidden's account, in the *American Journal of Science*, Volume XXXIII, page 222, 1887.

"It was about nine in the evening when I went to the corral to feed certain horses, when suddenly I heard a loud, sizzing noise, exactly as though something red-hot was being plunged into cold water, and almost instantly there followed a

somewhat loud thud. At once the corral was covered with a phosphorescent light and suspended in the air were small luminous sparks as though from a rocket. I had not recovered from my surprise when I saw this luminous air disappear, and there remained on the ground only such a light as is made when a match is rubbed. A number of people from the neighboring houses came running toward me, and they assisted me to quiet the horses which had become very much excited. We all asked each other what could be the matter, and we were afraid to walk in the corral for fear of getting burned. When, in a few minutes, we had recovered from our surprise, we saw the phosphorescent light disappear, little by little, and when we had brought lights to look for the cause, we found a hole in the ground and in it a ball of light. We retired to a distance, fearing it would explode and harm us. Looking up to the sky we saw from time to time exhalations, or stars, which soon went out, but without noise. We returned after a little and found in the hole a hot stone, which we could barely handle, which on the next day looked like a piece of iron; all night it rained stars, but we saw none fall to the ground as they seemed to be extinguished while still very high up."

From a careful reading of the above account, one who had made personal investigation of several meteoric falls would probably guess that what really happened was about as follows:

A large meteor fell, lighting up the country, and probably there were detonations. The detonations were, however, not as pronounced at the place of fall as farther back along the path of the meteor. The horses in the corral were frightened by the light and the detonations, and some of the neighbors probably noticed the phenomena. Mr. Mijares, the ranchman, who had not seen the meteor nor heard the detonations, stepped outdoors after the detonations, and just before the falling meteorite struck. He heard the swish and the thud, but, of course, could not at night see the meteorite as it fell. Looking up he saw the trail of the meteor as "luminous sparks as though from a rocket." The horses were "very much excited" by the light and detonations, followed by the swish and thud of the falling meteorite, and had stirred up considerable dust in the corral. In addition to this, the meteorite itself had thrown up a cloud of dust. As the eyes of the ranchman became accustomed to the darkness he saw this dust faintly illuminated by the light from the trail of the meteor as a "phosphorescent light" or "luminous air."

The neighbors, guided by the noise of the falling meteorite, arrived, but all were afraid to go into the corral "for fear of getting burned." The horses were spoken to and became quiet, and as the dust settled, and the meteor trail disappeared overhead, they "saw this luminous air disappear," and "the phosphorescent light disappear."

With things appearing normal they "brought lights to look for the cause," and found a hole in the ground. Approaching it cautiously, somebody saw the reflection of one of the lights from the smooth surface of the meteorite and announced that the hole contained "a ball of light." The party promptly "retired to a distance, fearing it would explode."

As the hole appeared perfectly dark they again approached cautiously, and seeing what appeared to be merely a dark stone, they proceeded to remove it. It was hot, but not too hot to handle. At the time of striking it was probably rather hot for handling, but not nearly hot enough to char wood or paper.

The account states that soon after the falling, the meteorite was removed and was not too hot to handle. This indicates that the temperature was far below that of boiling water, and that, if the meteor had been observed it would have

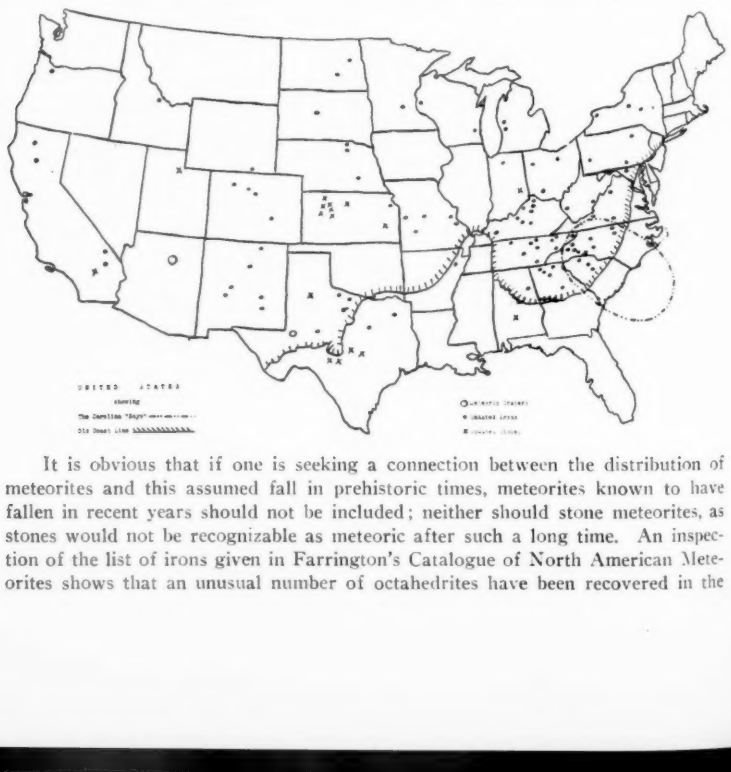
been seen to disappear at an altitude of several miles, as is the case with all meteors which have been carfully observed.

University of Iowa, April 29, 1933.

Iron Meteorites and the Carolina "Bays"

By C. C. WYLIE

In the *Journal of Geology* for January-February, 1933, Professors F. A. Melton and William Schriever of the University of Oklahoma publish an article on the Carolina "Bays." They give reasons for assuming that these bays are scars made by a fall of giant meteorites in prehistoric times. The time of origin is placed as between that of the Waccamaw-Pliocene (perhaps 20,000,000 years ago) and the late Wisconsin Pleistocene (perhaps 25,000 years ago). Since that time, the bays have been for a period below sea level, and consequently, their features have been much eroded. From a study of the direction of the elliptical axes of the depressions, they assume that the meteorites came from almost exactly 45° north of due west. The area over which it is assumed that the bays originally extended is shown on the accompanying map. This elliptical area includes all of South Carolina, most of North Carolina, small portions of Virginia, Tennessee, and Georgia, and a considerable area in the Atlantic Ocean. The authors state that, in the areas studied, they found no meteoric material, but this region has been below sea level since the date of the assumed fall. They refer, however, to the fact well-known among workers on meteorites that a very high percentage of American meteorites have been recovered in the south Appalachian region.



It is obvious that if one is seeking a connection between the distribution of meteorites and this assumed fall in prehistoric times, meteorites known to have fallen in recent years should not be included; neither should stone meteorites, as stones would not be recognizable as meteoric after such a long time. An inspection of the list of irons given in Farrington's Catalogue of North American Meteorites shows that an unusual number of octahedrites have been recovered in the

region northwest of any adjoining the elliptical area in which the Bays are found. On the map of the United States, we have, therefore, plotted all irons of this type for which the date of fall is not known. An inspection shows that there is a marked concentration in western North Carolina, eastern Tennessee, and Virginia. Several have also been recovered in northern Georgia, but none have been recovered in southern Georgia, eastern South Carolina, eastern North Carolina, and eastern Virginia, which regions, since the assumed date of the meteoric fall, have for a period been below sea level.

As a check on this method of investigating the reality of a concentration, the stone meteorites with the date of fall unknown were also plotted on the map. These show a marked concentration in Kansas, and there is a smaller group in Texas. Nine undated stone meteorites have been recovered in Kansas, seven of them in northwestern Kansas. Five have been recovered in Texas, four of them being rather close together in a group in southern Texas. These are the only states in which more than one undated stone meteorite have been recovered. Dr. O. C. Farrington assumes that the concentration in Kansas is due to soil and climatic conditions. The climate of Kansas is dry, and there are few rocks. A stone meteorite falling on the "buffalo" sod would not penetrate unless it was very large, and this stone lying on the sod would be so unusual as to attract the attention of anyone passing near by. Texas is also dry, and free from rocks, but this is not the case in most states. For example, if a stone fell in Iowa, it would normally sink into the ploughed fields. There are many natural rocks in the fields of Iowa, and if a stone meteorite is not noticed soon after the fall, its appearance becomes so much like ordinary rock that no one notices it. We have calculated that less than 1% of the meteorites falling in the United States are now being recovered. This is a such a small percentage that a concentration where chances for recovery are favorable is to be expected. The concentration of old irons in the south Appalachian region cannot, however, be explained as due to conditions favoring recovery. The climate is moist, favoring a relatively rapid disintegration of exposed iron. One would not expect the inhabitants of this region to be more faithful in reporting meteorites than those of other sections of the country. Yet about half the old iron meteorites of this type found in the United States have been recovered in this relatively small area.

The finding of these Bays gives support to the hypothesis that this concentration of irons in the Appalachian Mountains is the result of a single great fall in prehistoric times. On this assumption, the Bays were formed by the larger masses in the nucleus of the comet, or swarm of meteoroids. The Leonids produce many spectacular meteors at a distance of millions of miles from the nucleus, and it has been assumed that the nucleus of a large comet might include masses weighing many tons. If the nucleus produced the Carolina Bays, it is assumed that good sized meteorites might well have been dropped over the region in which these meteoric irons have been found. Such a shower would be very different from any fall of meteorites which has been observed. For example, at Amana, Iowa, meteorites were dropped over an area about 7 miles long and 2 miles wide, more than a hundred separate individuals being recovered. The greatest distance recorded is about 16 miles at Khairpur. For these falls, it is probable that all of the meteorites recovered are fragments of a single large mass, which was shattered in the course of its passage through the earth's atmosphere.

The collision of the earth with the head of a large comet would be very different. Brilliant meteors would be seen over that portion of the earth in darkness

and toward the comet, and it has been assumed that meteorites might fall over an area approximating in diameter the nucleus of the comet.

Recorded meteoric falls, being probably portions of one stone, usually show the similarity of different pieces of the same stone. For such a cometary shower, a greater difference would appear possible. Stones of greater difference than would ordinarily be found at the same fall might perhaps have fallen in the Appalachian region from the same comet; but as meteors from the same shower, for example the Leonid, resemble one another, analogy suggests that meteorites from such a shower would be similar.

University of Iowa, July 9, 1933.

The Yakima Fireball.

An unusually brilliant meteor, greenish in color, was seen from all parts of Oregon and Washington at 8:43 P.M., P.S.T., April 20. The press carried spectacular accounts of it the next morning and asked that certain data be sent at once (by those who saw it) to the Oregon-Washington representative of the American Meteor Society. This included direction and altitude of points of appearance and disappearance and a general description. Large numbers of letters were soon received thus making it possible to determine fairly accurately the region over which it passed and finally disappeared, and to estimate its height roughly.

The fireball evidently first became visible when over the territory a little east or northeast of Mt. Thielsen in Southern Oregon. It traveled a little east of north, passing nearly overhead at Bend, Madras, and Moro, Oregon, and Yakima, Washington. About 30 miles beyond Yakima it burst and disappeared.

Calculations of estimated angular altitudes, and intervals between the appearance of the object and the reception of the ballistic wave (thunder like sound) along various parts of its path give approximately the following heights: Near Mt. Thielsen, 70 miles; near Bend, 50 miles; over Moro, 30 miles, and over Yakima, 10 miles. The observer at Wymer, 20 miles north of Yakima, stated that "three explosions were heard a *few seconds* after disappearance." Another report mentioned the "three explosions," and another "three pieces" seen after the final breaking up.

Disintegration was active throughout its course. Large fragments broke off at quite regular intervals, each loss accompanied by a brilliant flare from the main body. This caused the puzzling throbbing of light on the southern sky, "as regular as heart beats," seen by those in the north before the meteor appeared above the horizon. Many mentioned the tail of huge red sparks, the constant scattering of particles in all directions from the head, and the luminous trails traced by the larger pieces as they fell earthward.

Already reports have come of the recovery of fragments in two localities. As soon as these are received, they will be sent to proper authorities for testing.

Eugene, Oregon. J. HUGH PRUETT.

Organization Meeting of the Society for Research on Meteorites

The organization meeting of the Society for Research on Meteorites will, through the courtesy of Director S. C. Simms and Dr. O. C. Farrington, be held in the lecture hall of the Field Museum of Natural History, Roosevelt Road and Lake Michigan, Chicago, Illinois, on Monday morning, August 21, 1933, at ten o'clock. All persons who have joined the Society as charter members and others

who would like to become charter members at that time, are cordially invited to attend. Any persons interested in the purposes or activities of the Society, as well as friends of members, also will be welcome.

Members who contemplate presenting papers or other communications at the meeting are requested to send in the titles, a statement of the time required for the delivery, etc., of these, to the Acting Secretary, by August 10, if possible, in order that they may be listed on the program. Members who are inclined to contribute to the program are heartily encouraged to do so. It is hoped that there will be a number of interesting papers and addresses.

The Acting Secretary will appreciate being advised by all members who intend to be present at the meeting. As the success of the occasion will depend considerably upon the number of persons in attendance, any member who can come is urged to do so.

The following is a list of those who have joined the Society as charter members: Dr. Armand W. Forstall, Director Seismic Station, Regis College, Denver, Colo.; Chas. H. Hanington, President, Board of Trustees, Colorado Museum of Natural History, Denver, Colo.; Hugh G. Harp, Director, Elgar Weaver Observatory, Wittenberg College, Springfield, Ohio; George Irving Hopkins, Curator, Manchester Institute of Arts and Sciences, 841 Beech St., Manchester, N. H.; Frank Howland, 2525 West 34th St., Denver, Colo., Minerals, Colorado Museum of Natural History; Mrs. Anne Atwood King, Colorado Museum of Natural History, Denver, Colo.; E. T. Nichols, 237 Brattle St., Cambridge, Mass.; Floyd E. Studer, 637 Amarillo Building, Amarillo, Texas; R. F. Torrance, Cananea, Sonora, Mexico.

FREDERICK C. LEONARD, *Acting President*, Department of Astronomy, University of California at Los Angeles;

H. H. NININGER, *Acting Secretary*, The Nininger Laboratory, 1955 Fairfax Street, Denver, Colorado: 1933 July 3.

Zodiacal Light Notes

By FRANKLIN W. SMITH

The zodiacal light could be traced to Leo on May 22. The apparent apex was not far from Eta Leonis; its elongation was therefore about 87° from the sun while the axis of the light was 50° or 60° north of the ecliptic. At this season of the year the inclination of the ecliptic to the horizon in the early evening decreases rapidly from night to night and the conditions of visibility of the zodiacal light become correspondingly poorer. It was seen with difficulty on June 11, but again could be traced only as far as Leo. The elongation of the apparent apex on that date was 68°.

It is scarcely necessary to add that naked-eye observations of the zodiacal light do not determine either its bounadaries or its brightness with any high degree of accuracy. More accurate methods of observation are therefore to be desired. Several photometric observations have been made, but apparently these have not come to the attention of many observers. Apparently the first quantitative measurement of the brightness of the zodiacal light was made by Burns[1] who found that at an elongation of 40° from the sun, it was 40% to 50% brighter

[1] Burns, G. J.: Journal of the British Astronomical Association, Vol. XIII, p. 316.

than the background sky. The most comprehensive set of photometric observations available at the present is the work of Hoffmeister.[2]

Such observations may be made with simple apparatus which is well within the reach of the amateur observer. The writer has made a few observations with a surface photometer of the type described by Hoffmeister. On May 22, the brightness of the zodiacal light at a point on its axis and 48° from the sun was 1.30 times that of the sky at the zenith; at elongations of 64° and 87°, respectively, the relative intensities were 1.16 and 1.03. (The zenith distances of these three points at the times of the observations were 72°, 63°, and 55°, respectively.) Because of the unfavorable position of the ecliptic at this time of the year, it has been impossible to continue the observations.

407 Scott Ave., Glenolden, Penna., July 5, 1933.

[2] Hoffmeister, C.: Veröffentlichungen der Universitätssternwarte zu Berlin-Babelsberg, 8, Heft 2, 1930.

General Notes

This issue is somewhat late because of delays arising from the fact that the editor is absent during the period of publication. However, as this issue is for the two months of August and September, the delay is not serious, because it merely lessens the time interval between this and the October issue, which will be mailed as usual on or very near the first of that month.—Ed.

Dr. Willem deSitter, director of the Leiden Observatory, has been elected a correspondent of the French Academy of Sciences, Section for Astronomy.

Dr. Frank Schlesinger, director of the Yale University Observatory, has been elected a foreign correspondent of the French Academy of Sciences. These elections are limited to six astronomers at any one time.

Dr. E. A. Fath, associate editor of Popular Astronomy, left Northfield in June by automobile for California. Dr. Fath will spend the coming year in research at the Lick Observatory. Mrs. Fath and their daughter, Miriam, accompanied him.

Dr. William Lewis Elkin, formerly director of Yale University Observatory, died at his home in New Haven on May 29, at the age of seventy-eight years. He had been in ill health for many years, having retired on this account at the age of fifty-five in 1910.

Mr. W. R. Jewell of Danville, Illinois, died on June 18 after a long illness at the age of sixty-four. A lawyer by profession, he had for many years an enthusiastic amateur's interest in things astronomical. He observed several eclipses, and he will be well remembered by those who were at Catalina Island in 1923. For a time he was a regular attendant at the meetings of the American Astronomical Society, where his genial personality made him the life of any group. It was a satisfaction for him to use his legal knowledge in guiding the steps taken to incorporate the Society in the state of Illinois. Jewell was in local demand as a speaker on astronomical and other topics, and he was drafted for various public services in his home community. His first telescope was a small

refractor; later he came into possession of one of the earliest if not the first of the reflectors made by Brashear, with aperture of 15 inches. Shortly before his death he donated this instrument with its building and dome to Wabash College, where he was able to see the equipment installed in the Jewell Observatory.

It was often Jewell's contention that an interest in the stars shapes a man's character, and in his own case the heavens looked down on a rare spirit who will be missed by many friends.

William Francis Herschel Waterfield.—Grim tragedy has again stepped in to deprive the Harvard Observatory staff of one of its valued members, this time to take by sudden death William Francis Herschel Waterfield, chief assistant at the Boyden Station near Bloemfontein, South Africa. Mr. Waterfield died on May 16 as the result of a motorcycle accident. He was enroute from the Observatory to his living quarters when he collided with a mule-drawn milk wagon.

Mr. Waterfield was born in London, England, on June 1, 1895, and received his B.A. degree from Cambridge University. As his name indicates, he was a direct descendant of Sir William and Sir John Herschel, his mother being the daughter of Sir John. Waterfield appears to have inherited directly a love for astronomy and music for he was intensely interested in both from early boyhood. For some years previous to and following the World War, he resided in Naskup, B. C., where besides being actively engaged in the lumber business he maintained an active interest in variable star observing, using a 12-inch Calvin reflector imported from England. At first contributing his observations only to the Variable Star Section of the British Astronomical Association, in 1921 he joined the ranks of the A.A.V.S.O., to which he contributed many hundreds of observations of variable stars, especially in their faint stages.

In 1926 his wife met a tragic death by drowning at Naskup, so Waterfield sent his three children to relatives in England and he himself joined the Harvard Observatory staff at Cambridge, Massachusetts, where he was able to make good use of his training at the telescope in estimating magnitudes from photographic plates. In 1928 he was appointed chief assistant at the newly erected Boyden station in South Africa. Here he became most expert in operating the photographic telescopes and his plates, taken with the 24-inch Bruce instrument, were among the best ever secured.

For the past three years the two oldest children resided near or with him at Bloemfontein and his son, Hugh, had for the past few months been associated with him as an assistant at the Observatory.

Mr. Waterfield was a great lover of the best in music and greatly enjoyed his hours with the records of the great music masters. He was no mean pianist himself and at the time of his death was honorary treasurer of the Music Club at Bloemfontein.

Waterfield made many friends and long kept such friendships. A man proud of his ancestry, an indulgent father, a loyal friend, a master of the art of practical observing, he will be sorely missed by his many friends in many lands.

LEON CAMPBELL.

The Total Solar Eclipse of 1934 February 13-14

This eclipse will be visible from the Dutch East Indies and from a few islands among the Caroline Islands. The National Research Council of Japan has circulated to the principal observatories details of the observing conditions at Oroluk and Losap in the Caroline Islands and of the generous offer of the Japanese Gov-

ernment to transport eclipse parties free of charge from Yokohama to these islands and back. The following details have been received from Dr. Minnaert of the Heliophysical Laboratory at Utrecht with regard to possible observing stations in the Dutch East Indies.

Boeli: 0° 50′ N, 128° 15′ E, at sea level on the east coast of Halmaheira; quite near the central line; very good probability of sunshine but with difficulties likely in landing eclipse stores; small village near but no large town.

Ternate: 0° 45′ N, 127° 20′ E. Weather conditions promising on the S.E. coast, which is far from the central line. No details of the N.W. coast available.

Ratahan: 1° 5′ N, 124° 47′ E, at a height of 400 m near the S.E. coast of Celebes; less probability of sunshine but with good road communications to larger centers.

Amoerang: 1° 12′ N, 124° 34′ E, on the northwest coast of Celebes; good prospects of sunshine but more likelihood of rain.

Cambridge, May 10, 1933. F. J. M. Stratton.

The Adler Planetarium and Astronomical Museum is one of the most popular points of interest at A Century of Progress Exposition. In order to accommodate the crowds it is necessary to give fourteen demonstrations daily. The editor of this magazine, Dr. Alter of the University of Kansas, Dr. Bartky and Dr. Everett of the University of Chicago, Dr. Crull, and Dr. Marshall are assisting the regular staff of the Planetarium in this enlarged program.

The Fiftieth Meeting of the American Astronomical Society was held at the Adler Planetarium in Chicago on June 22, 23, 24. An account of this meeting will appear in the October issue of Popular Astronomy.

The Fels Planetarium.—The second Zeiss planetarium in the United States will be in operation before the end of October in Philadelphia when the Fels Planetarium is opened as part of the astronomical section of the Benjamin Franklin Memorial and the Franklin Institute. An innovation in planetarium dome construction has been introduced by making the projection surface of perforated sheet metal. Stainless steel, punched with sixteenth-inch holes, an eighth-inch apart, is employed. Before erecting, these sheets were formed to the proper radius of curvature (10 meters). The sheets are welded together around the edges, so that the dome is accurately hemispherical, unlike any of the other planetarium domes so far erected.

Acoustic tests have shown that the perforated metail is as completely pervious to sound as the stretched cloth used in other planetaria. On the walls behind the dome have been placed approximately 6,000 square feet of sound absorbent blanket, so that objectionable echoes will be completely avoided.

The planetarium instrument itself will be essentially the same as in other recent installations, except that some improvements have been made by the Zeiss firm with a view to facilitating the manipulation. Chief of these is a new type of switchboard.

A tentative schedule of 28 lectures per week, including special demonstrations for the Philadelphia school children, has been arranged. These will be given by James Stokley, associate director of the Museum, in charge of the astronomy department, Wagner Schlesinger, his chief assistant, and several other lecturers, who will serve part time.

In addition to the Fels Planetarium, which is the gift of Mr. Samuel S. Fels, the astronomical section of the Museum will include an observatory for the use of the public, of which the chief instruments will be a 24-inch reflector, by Fecker, and a 10-inch refractor, of the Urania type, by Zeiss. These will be placed on the top floor, under a sliding roof, 22 x 40 feet. Numerous photographs of astronomical subjects, mostly from the Yerkes and the Mt. Wilson Observatories, will be displayed as transparencies, and a number of historic telescopes, and astronomical models, will be shown.

The Astronomy Club of Rochester

The Astronomy Club of Rochester, which held its first meeting on the evening of October 20, 1932, at The University of Rochester, now has about fifty members. Its regular bi-monthly meetings have feature programs of speakers, and of observations when the weather permits. About half a dozen members of the club have made their own telescopes which are now being used for informal summer meetings. The club is preparing to participate in the Meteor Program of the Byrd Antarctic Expedition II. The club desires to coöperate with similar groups working elsewhere in the United States. Correspondence may best be addressed to Professor Floyd C. Fairbanks, University of Rochester, Rochester, New York.

RALPH S. BATES, *Secretary.*

210 Rugby Avenue, Rochester, New York, June 14, 1933.

An Astronomical Pioneer

With the wonders of modern astronomy, and the marvelous telescopes which we have today, it is well for us to stop and remember the early pioneers of this great science in America, whose faith and perseverance prepared the way for the triumphs of today. Among these few are more worthy of our honor than Professor O. M. Mitchell of Cincinnati College. It was in the year 1840 that Professor Mitchell proceeded in the face of great difficulties to carry out his dream of securing a telescope for the college he served. He faced a large degree of indifference to his plan, which was quite natural at the time, but with great perseverance he succeeded in getting pledges of $9,500 to purchase a telescope (which however small it may seem now was a large amount for those days). Money was very scarce and it was necessary to take payment of pledges in barter of various kinds, which often required "four or five barterings," according to the records, before money was obtained. To cap the climax of difficulties "this season was one of great depression" and those who had given pledges were often unable to pay. It looked as if the cause was doomed but the victorious spirit conquered all obstacles, and the money was finally in hand just in time to meet obligations.

Professor Mitchell's troubles did not end here, however, for he had no place for his telescope, when it should arrive from Europe. Thus facing another great problem he began work in 1844, with only two men to build his Observatory (not having money to pay more workmen). He was able gradually, however, to add more men for the work.

This indomitable man, aside from carrying on his college work, raised the money to pay workmen and obtain materials. With the continuing scarcity of money he was obliged to barter all kinds of gifts, including such mundane articles as pork barrels and lard kegs. Never perhaps in the history of the science were such prosaic material things used for the high purpose of studying the wonders of the heavens. His resourceful ingenuity in building his observatory made him a

master of economy. He opened a lime kiln on the site of the structure, and made use of a near-by sand bank for necessary materials. He also drove a teamster's cart himself, for an entire day, to establish what a day's work should be for such labor.

It is good to know that this great leader and pioneer of astronomy in America came into the full enjoyment of his telescope won by such sacrifice and perseverance. For a period of sixteen years he carried on notable work in his observatory.

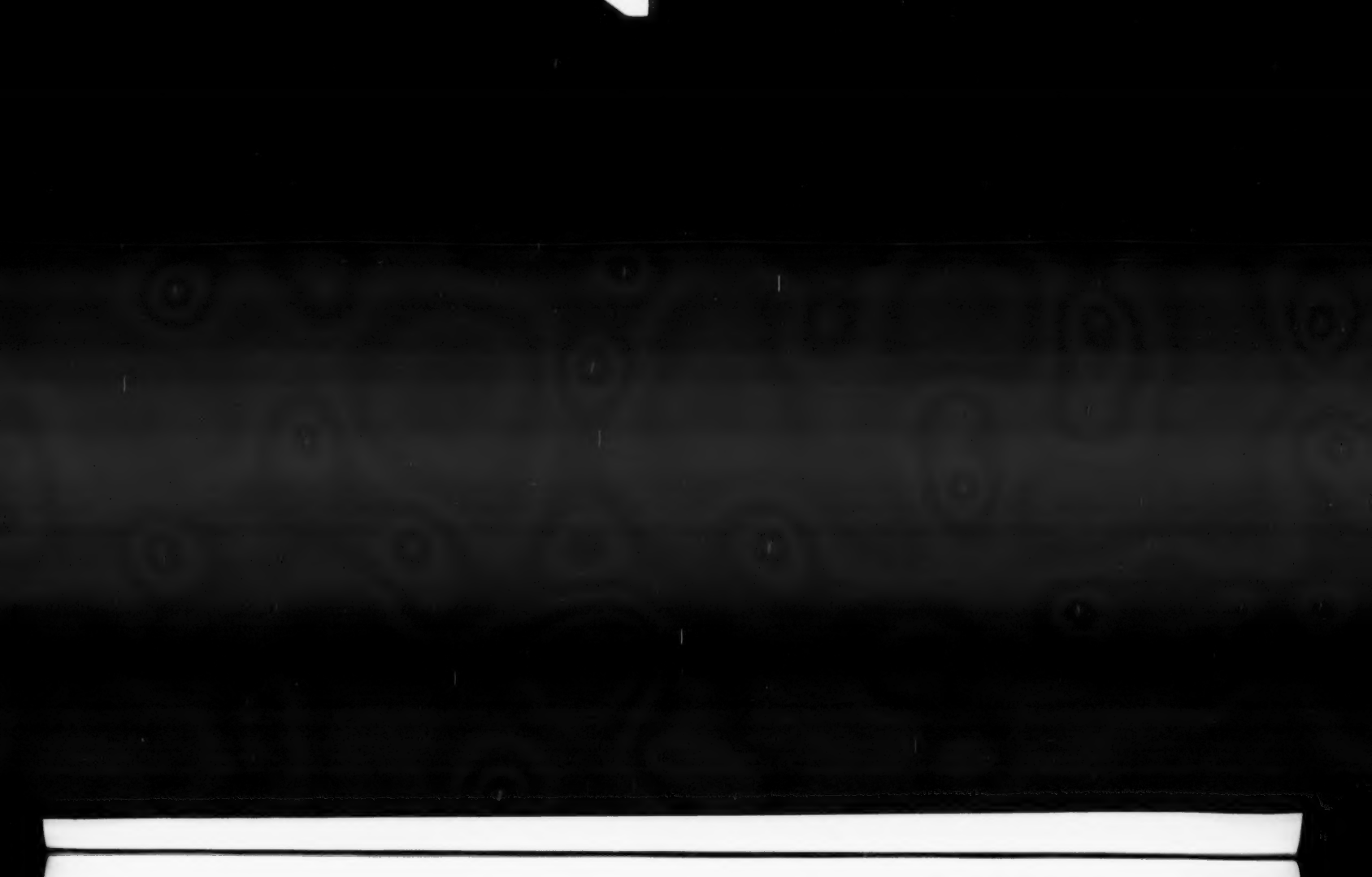
Froude in his essay "Representative Men" speaks of great heroic lives that leave pathways for those that come after them, like the early trails of the pioneers through the forest. Pathways to guide the feet of others along the way of heroic service and achievement. Professor Mitchell certainly should be numbered among this company of noble souls, in honor of his triumphant faith and courage in bringing to men new revelations of the wonders and glories of the heavens.

Woodbury, Connecticut, November 16, 1932. CLINTON W. WILSON.

Book Reviews

Portrait Gallery of the Astronomische Gesellschaft.—This pamphlet issued in Budapest in 1931 by A. Tass is in a sense a second edition of a similar pamphlet issued in 1904. The recent edition contains photographs and biographical sketches of 334 members, and a supplementary list of 181 members who did not furnish the necessary personal data. The pamphlet is very interesting and valuable as a source of information concerning many well-known astronomers. The text is in German.

The Junior Astronomy News (Summer Fieldbook) is a collection of twenty mimeographed pages attractively bound in a red paper cover, issued under the auspices of The Junior Astronomy Club of the American Museum of Natural History, 77th Street and Central Park West, New York City. It contains various charts and diagrams and numerous suggestions for those beginning the study of astronomy. Copies may be secured from the club indicated for ten cents each.

Publications of the Remeis Observatory at Bamberg, Volume I, Part III, has recently been received. This work contains a discussion of Hartwig's observations of variable stars by E. Zinner. It contains some 40,000 observations made by Hartwig prior to 1923 but not published before. It is a large sized volume of more than six hundred pages, apparently done by a mimeographing process.

The Nantucket Maria Mitchell Association, Nantucket, Massachusetts. A pamphlet of sixty-four pages constituting the thirty-first annual report of the activities of this association has recently been received. In the first item in a Chronological Record we learn that the headquarters of this association are now in the house on Vestal Street, Nantucket, now known as "Memorial House," in which Maria Mitchell was born on August 1, 1818. The association is active in several fields in addition to the work carried on at the astronomical observatory under the direction of Miss Margaret Harwood. This report contains an interesting, well-illustrated account of the eclipse expedition from this observatory, on August 31, 1932.